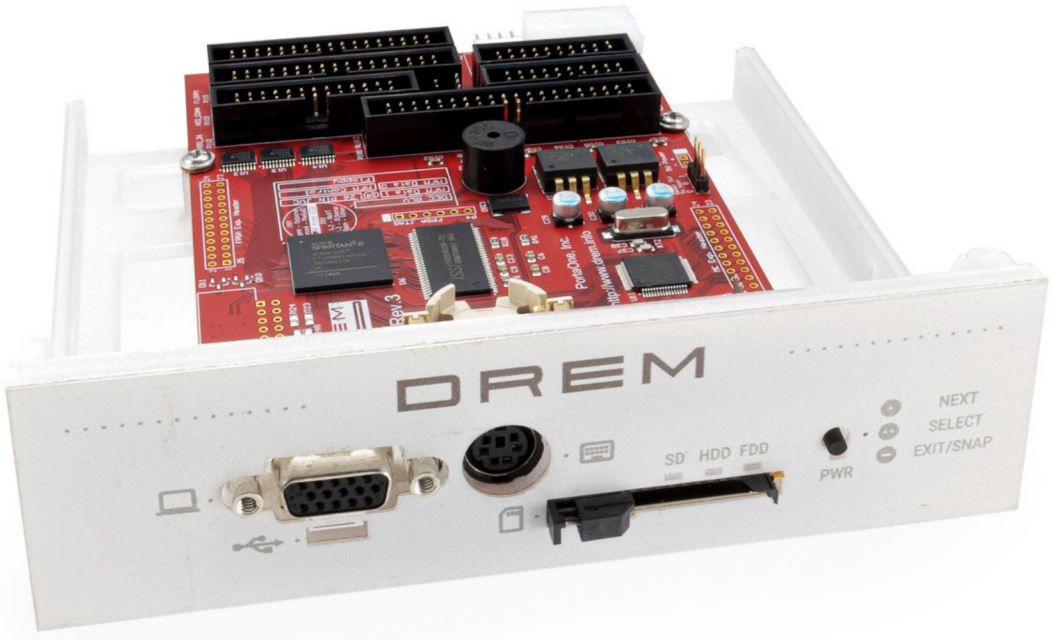
DREM

MFM/RLL DRIVE EMULATOR

Version 3.0

User Manual



こだわり

Copyright Notice & Disclaimers

DREM™ User manual, August 7, 2022

Please address your comments and suggestions to: Sales Department, PortaOne, Inc. A113 – 2099 Lougheed Hwy, Port Coquitlam, BC V3B 1A8 Canada. Changes may be made periodically to the information in this publication. The changes will be incorporated in new editions of the guide. The software described in this document is furnished under a license agreement, and may be used or copied only in accordance with the terms thereof. It is against the law to copy the software on any other medium, except as specifically provided for in the license agreement. The licensee may make one copy of the software for backup purposes. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopied, recorded or otherwise, without the prior written permission of PortaOne Inc.

The software license and limited warranty for the accompanying product are set forth in the information packet supplied with the product, and are incorporated herein by this reference. If you cannot locate the software license, contact your PortaOne representative for a copy. All product names mentioned in this manual are for identification purposes only, and are either trademarks or registered trademarks of their respective owners.

Table of contents

Caution

CAUTION

- **This DREM device contains components that can potentially be damaged by electrostatic discharge.**
- **Handle using an antistatic wristband.**
- **Operate on an anti static work surface.**

For more information on proper handling, see ESD advice from Intel
http://www.intel.com/content/www/us/en/processors/packaging-chapter-06-databook.html

General description

The DREM (DRive EMulator) is an FM/MFM/M2FM (MMFM)/RLL/ARRL FDD + HDD emulator or MFM/RLL SSD. It allows you to emulate any floppy disk drive AND MFM hard drive SIMULTANEOUSLY and use an SD card media instead. DREM is based on the high performance FPGA platform and does not require the use of a PC for any file encoding operations.

DREM uses DSK disk image files, which contain the raw dump of a disk. The raw image consists of a sector-by-sector binary copy of the source medium. Since DSK files hold no additional data beyond the disk contents, DREM uses an additional CFG file to obtain disk geometry and encoding information.

DREM is equipped with a VGA output, PS/2 keyboard input and file manager software. A user can browse the SD card and insert DSK images into virtual drives. Use of a monitor and keyboard is optional: DREM may load default configuration from file on power up. With an optional VGA monitor and PS/2 keyboard users may access a live transaction log and monitor drive activity in great detail. At any time a user may start or stop capturing log data into a file on the SD card, which is very useful for analyzing low level format information. DREM comes with many CFG files for frequently used host computers. However, if you are not quite sure about the low level format for a particular host, DREM will provide an analysis in a log file captured during low level format (LLF) operations.

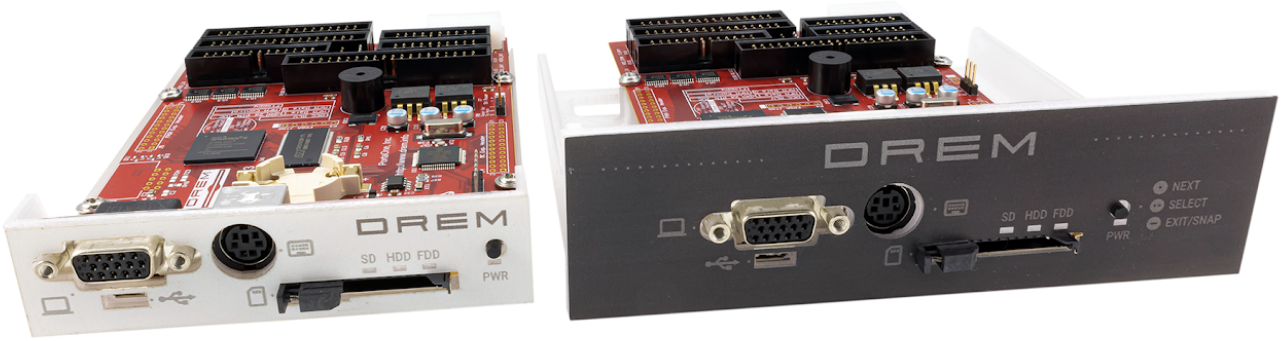
Installation

ATTENTION

Please download and install the latest DREM software first!
https://www.drem.info/

Mounting options

5”25, 3”5 and 8” mounting brackets are available for purchase https://www.drem.info/buy. Each comes with 2 front panel stickers (black and white), 8 screws, 4 washers.



Powering options

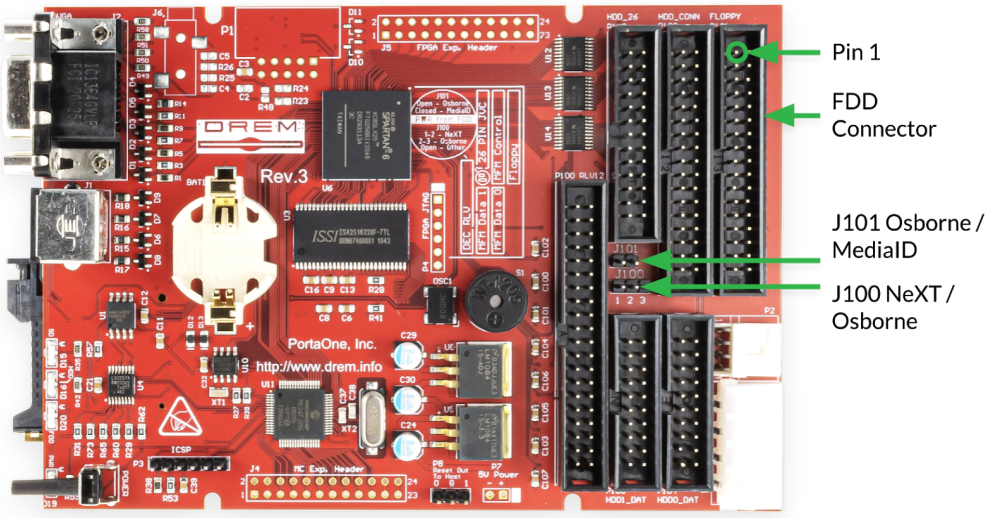
CAUTION

For reliable operation, ALWAYS power DREM from HOST power supply!

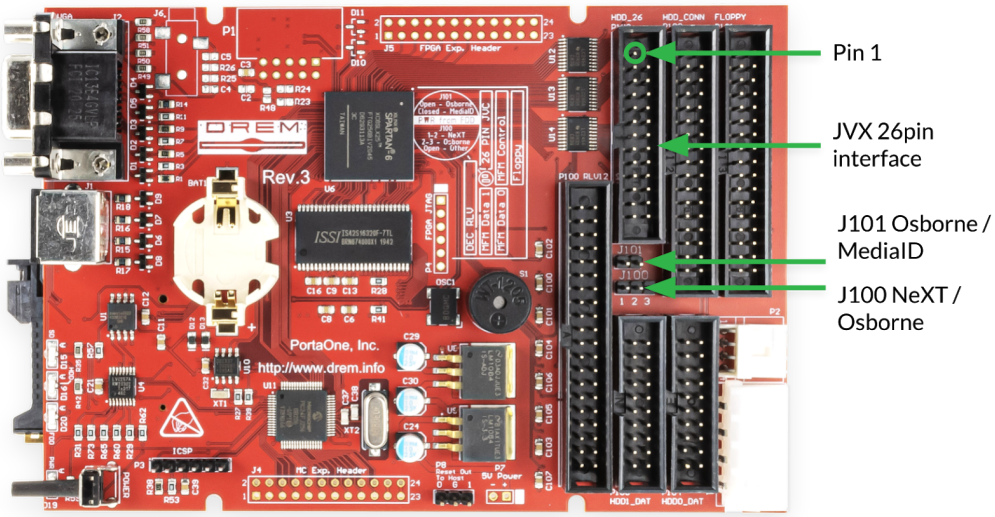
A. Via standard PC style 3”5 or 5”25 bay MOLEX connectors.

ATTENTION: J100 and J101 must be OPEN. Never power DREM via MOLEX connectors if J100 or J101 is closed.

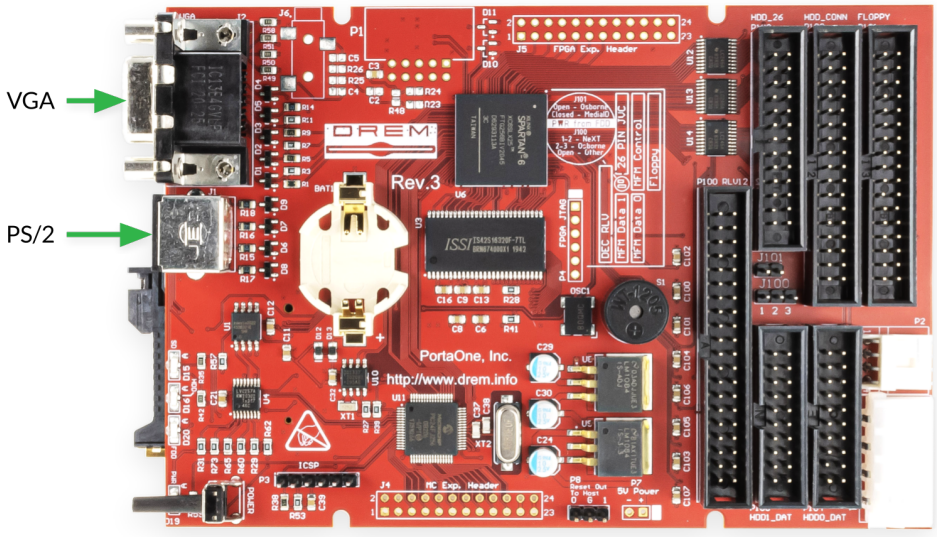
B. For NeXT/Osborne computers via FDD interface connector, configured by J100 and J101.



C. Via JVC 26pin interface. **ATTENTION: J100 and J101 must be OPEN.**



Optional VGA Monitor, PS/2 Keyboard and Mouse



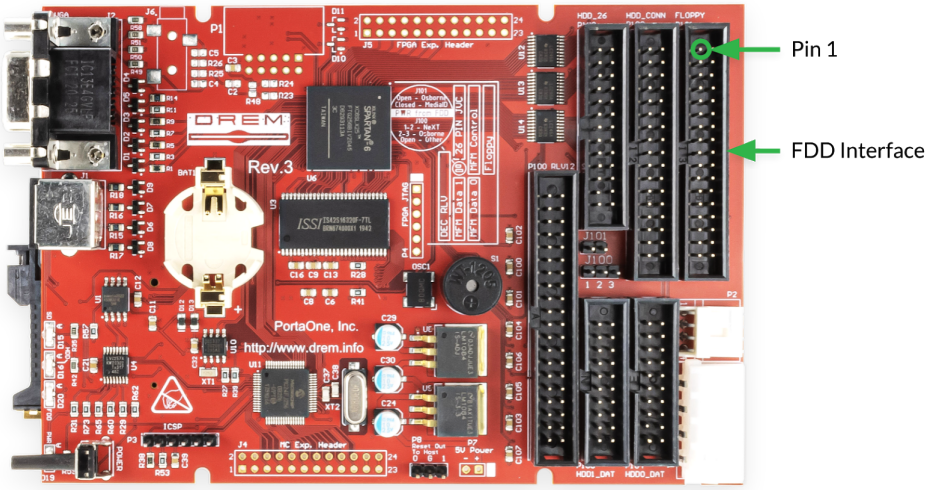
DREM can be controlled using a regular PC PS/2 keyboard or Numeric PS/2 keyboard.

PS/2 Mouse can be connected using PS/2 Y cable.

USB keyboard and mouse can be connected with USB to PS/2 connectors and PS/2 Y cable.

NOTE: Keyboards can be connected directly to DREM. Direct mouse connection is not possible. Mouse must be always connected using the PS/2 Y cable.

FDD Interface

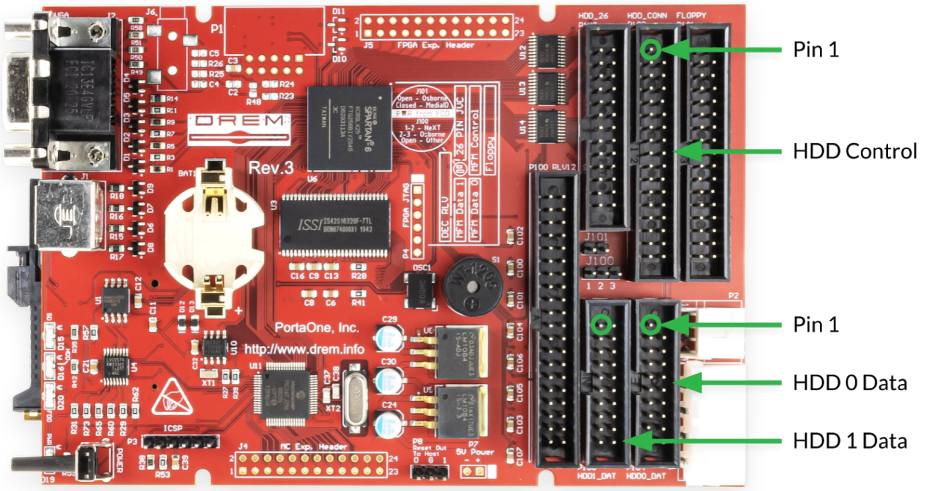


Connect the FDD interface using a standard FDD cable (not included). The Shugart 50-pin interface may be connected using a simple passive adapter.

TIP: A straight or twisted cable may be used. If twisted cable is used: select appropriate option in CFG file.

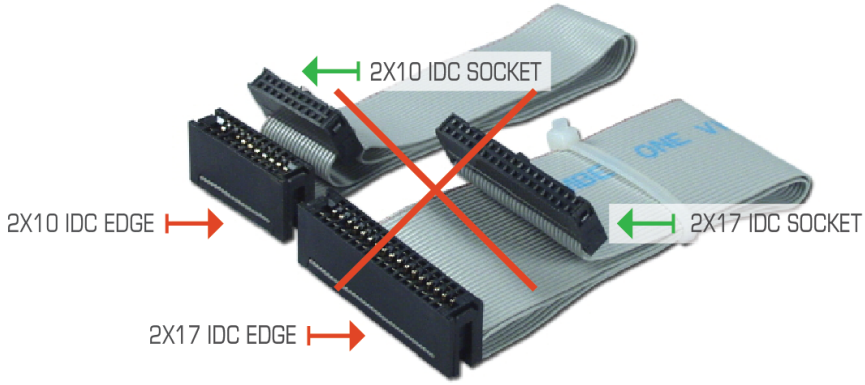
TIP: Pay close attention to J100 and J101. Both must be **OPEN** for all types of host devices except NeXT/Osborne.

ST506/ST412 HDD Interface



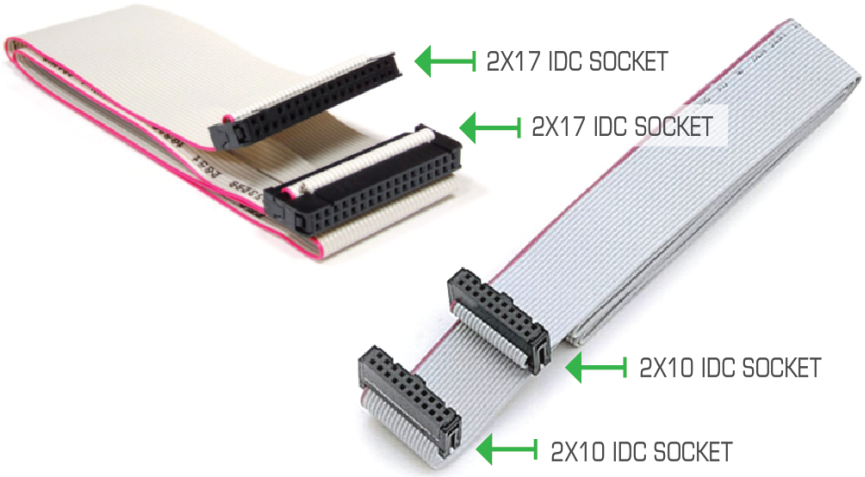
Connect the HDD interface using two ribbon cables (not included).

TIP: Standard MFM/RLL cables have 2.54mm pitch IDC pin sockets on the controller side and IDC edge connectors on the HDD side.



For connecting DREM cables you must have 2.54mm pitch IDC pin sockets on both sides. Total control cable length must not exceed 20 feet (6.10m). Each data cable length must not exceed 20 feet (6.10m).

NOTE: There are a few exceptions: for instance for Adaptec ACB4000 (Emulator E-Mu II+HD), ACB5000 series controllers and similar, 2x17 IDC EDGE cable is required.



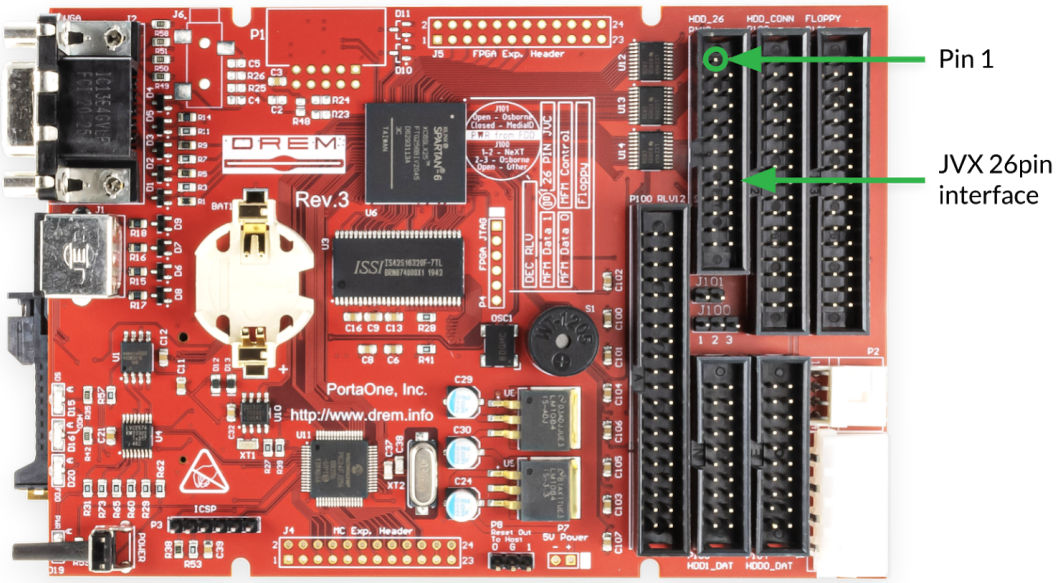
You must obtain an appropriate cable or crimp on additional 2.54mm pitch IDC pin sockets (not included) next to the IDC edge connectors on the existing cables.

***TIP*:** HDD Control cable may be replaced with straight FDD cable.

Cables and connectors may be purchased on Amazon and eBay. Crimping instruction videos are available on YouTube.

Please see **Appendix 3** for information on four drive operation of ST506/ST412 interface.

JVC 26pin HDD Interface

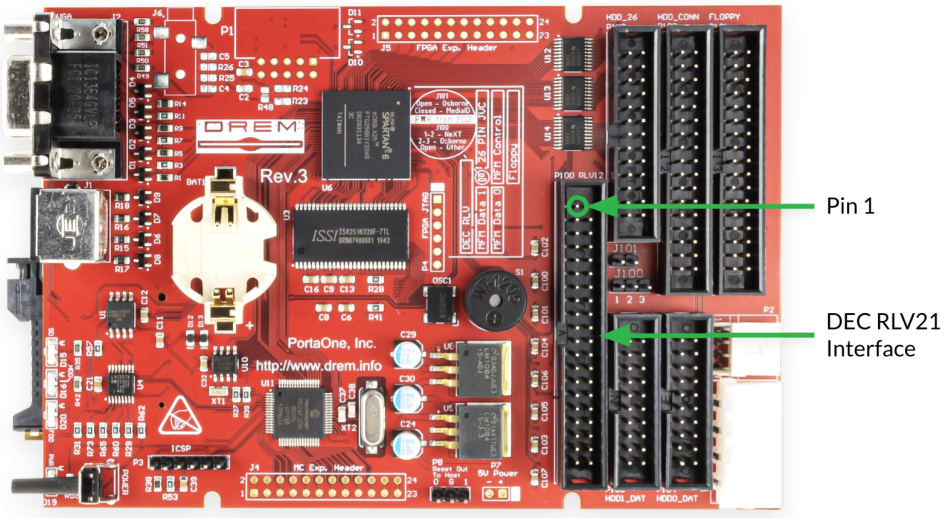


JVC 26pin interface is used with portable systems such as:

- Data General One Model 2T
- Epson PX-16
- Epson Equity LT
- Epson Portable PC (Q150A)
- GRiD 1520
- GRiDCase 3 Plus
- Sharp PC-7200
- Toshiba T1200
- Victor V86P
- Wang WLTC Laptop

ATTENTION: When JVC 26pin connector is in use, DREM power is drawn directly from the interface cable. Please make sure you are not connecting power to DREM by any other means.

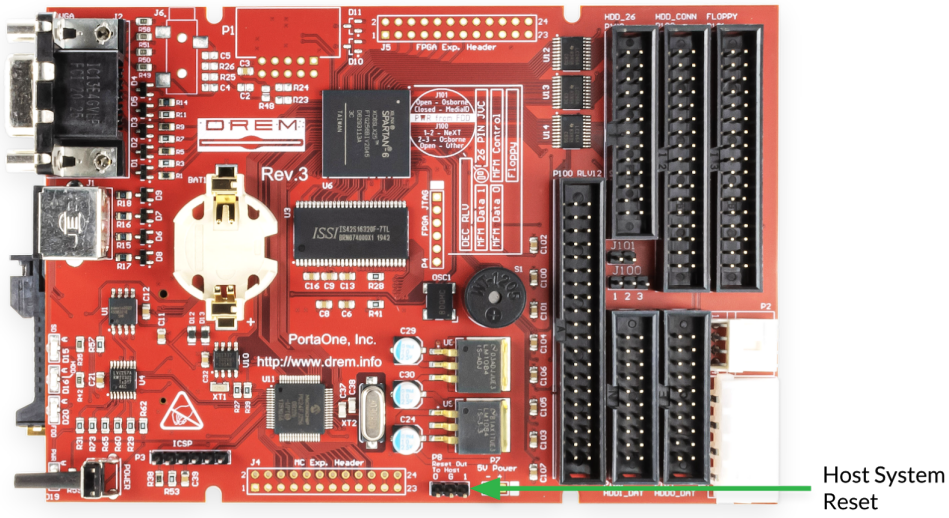
DEC RLV21 Interface



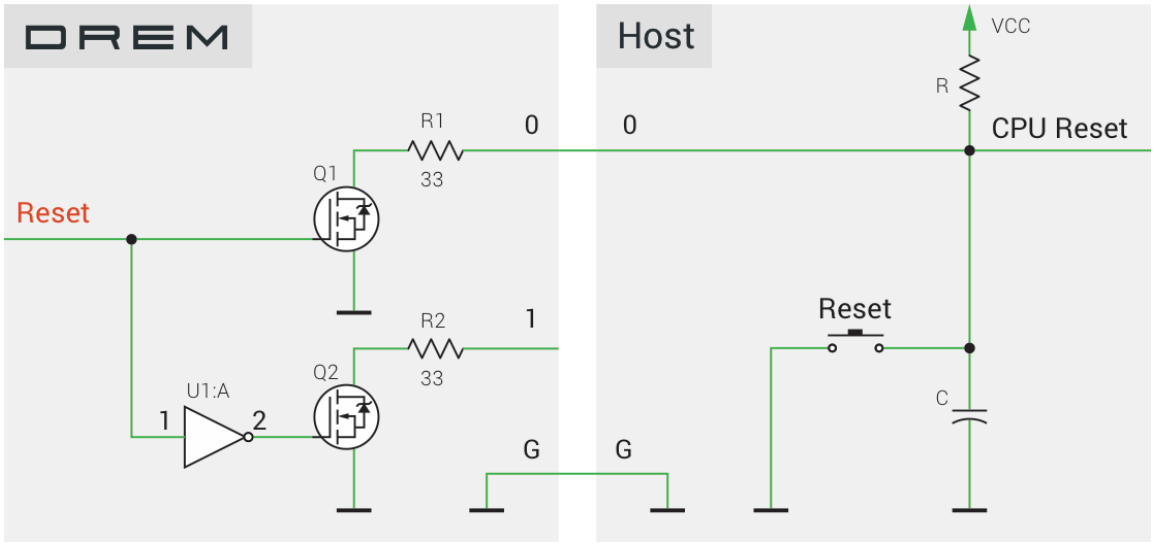
Maximum Cable Length 30 m (100 ft). Up to 4 DL drives are supported. DEC RLV12 has no “auto deselect” feature, therefore a second DREM is required for FDD simulation.

Host Reset (Optional)

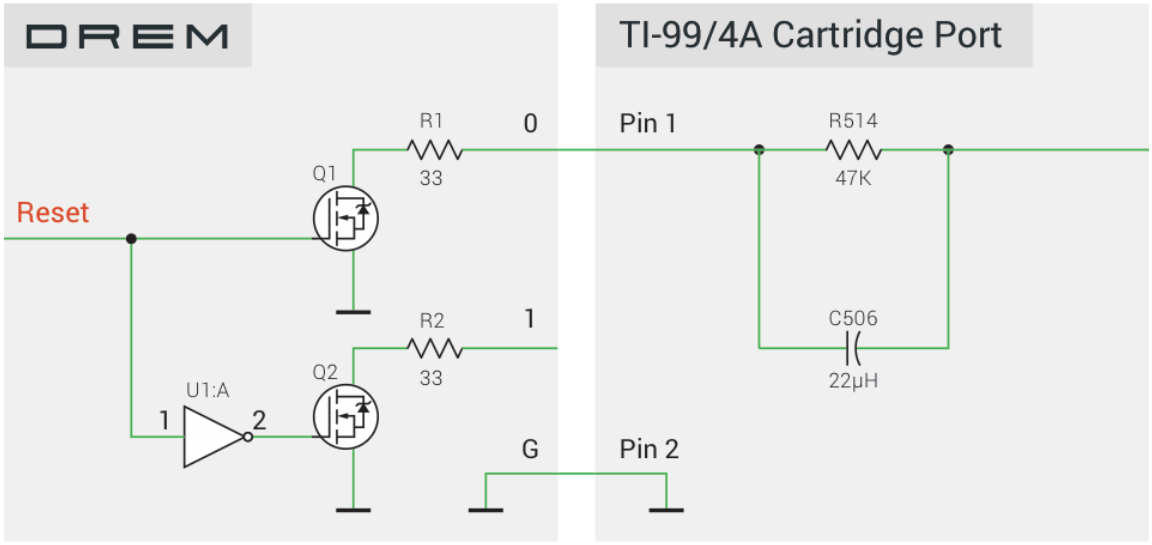
DREM power up boot time is 7 seconds. For most applications (i.e. PC) this is not a problem, but some host systems expect HDD to be instantly ready. DREM is equipped with auxiliary reset outputs, which may be connected to host system reset circuits in order to delay host system startup until after DREM is ready.



Typical host system reset circuitry:



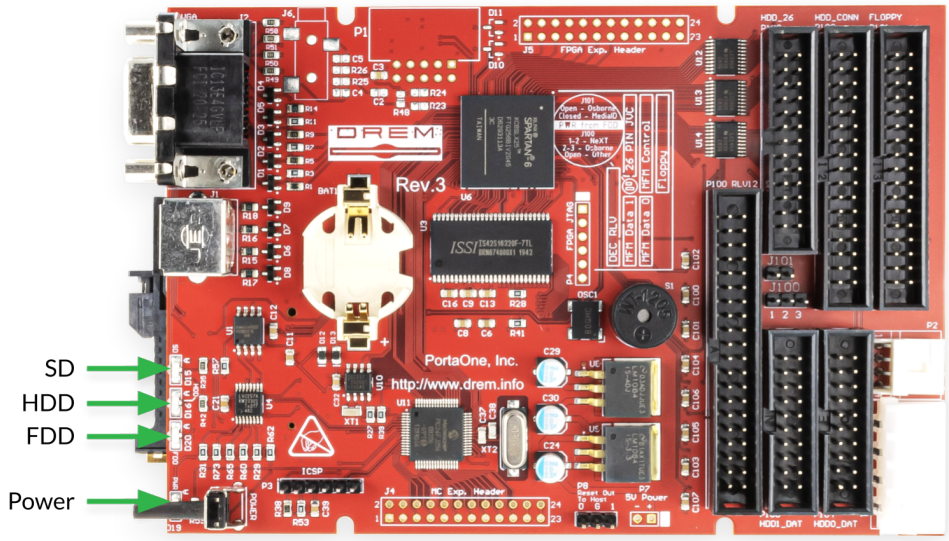
Even if your host system does not have a RESET button it will have an RC reset circuit.



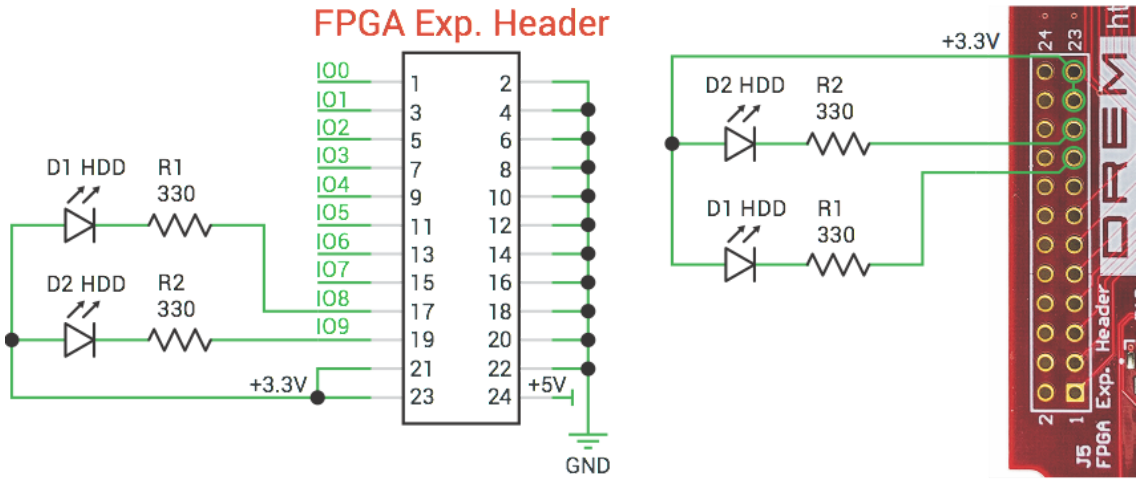
Activity LEDs

DREM is equipped with dual color 90 degree light output LEDs for displaying read / write activity.

ATTENTION: SD LED is indicating cache status. Do not power down DREM while the SD LED is on!

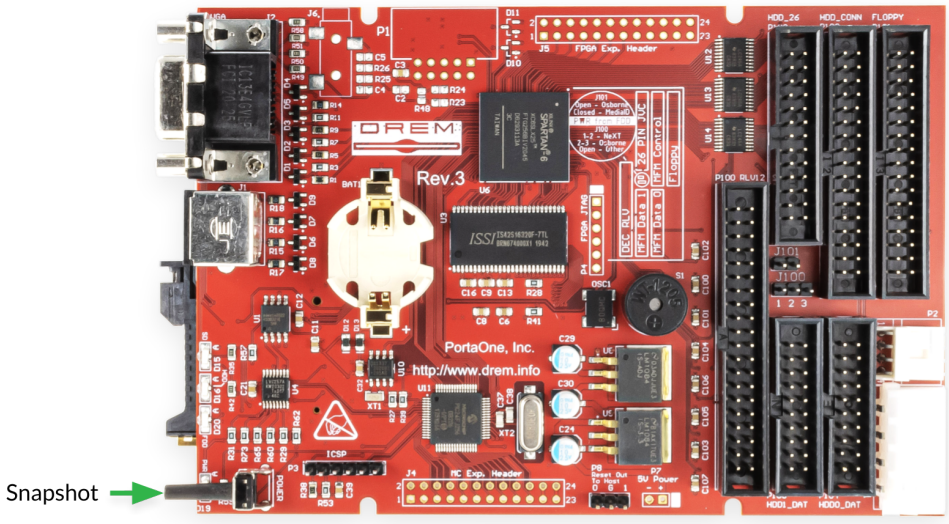


For some installations it may be desirable to install a remote auxiliary FDD/HDD activity LED's. Auxiliary LED's signals is available from FPGA Expansion Header:



Snapshot Button

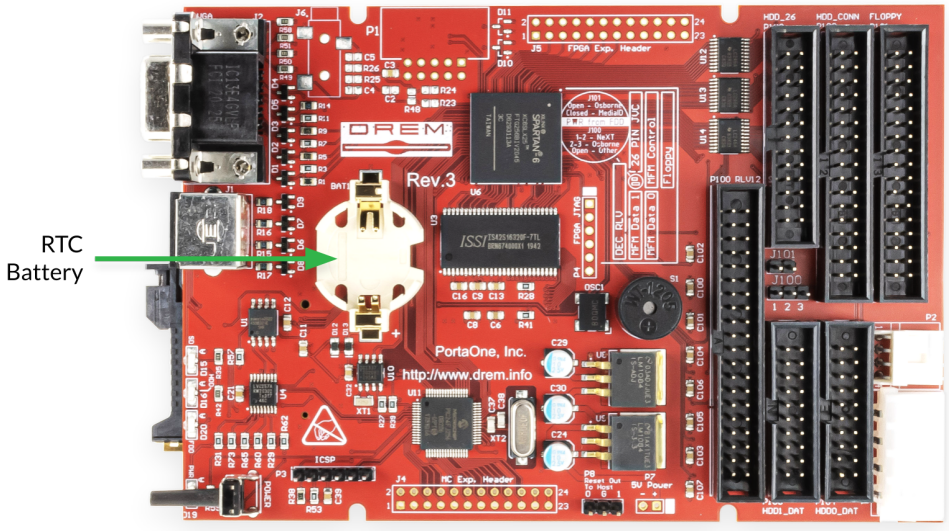
Pressing and holding Snapshot Button in console mode creates instant copy of DSK disk images without interrupting host computer current disk operations.



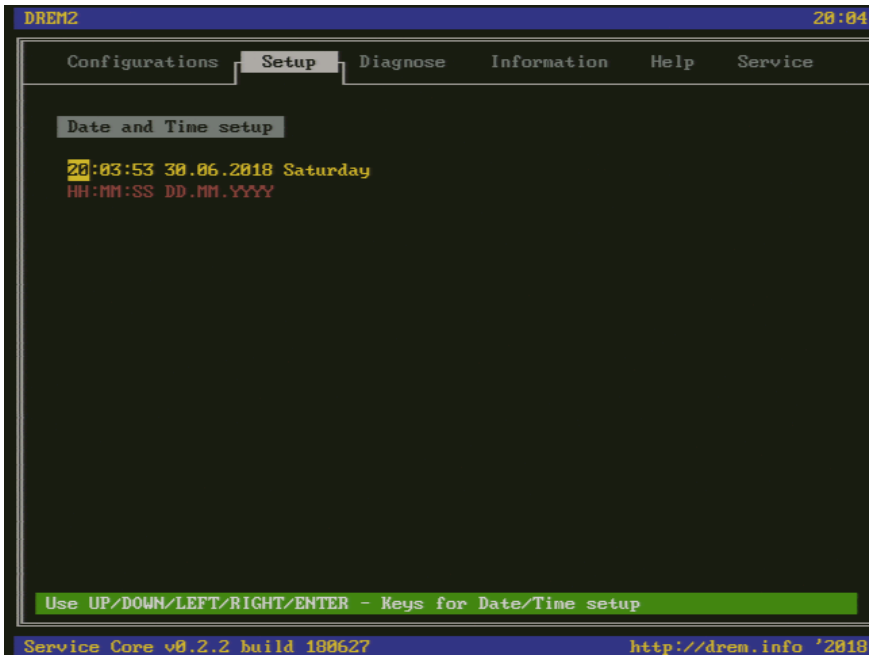
Real Time Clock (RTC)

DREM is using RTC for naming log and snapshot files and timestamping files on the SD file system. CR2032 lithium battery (not included) must be installed for real time clock (RTC) operation.

ATTENTION: Polarity is important! Battery "+" must be facing up.

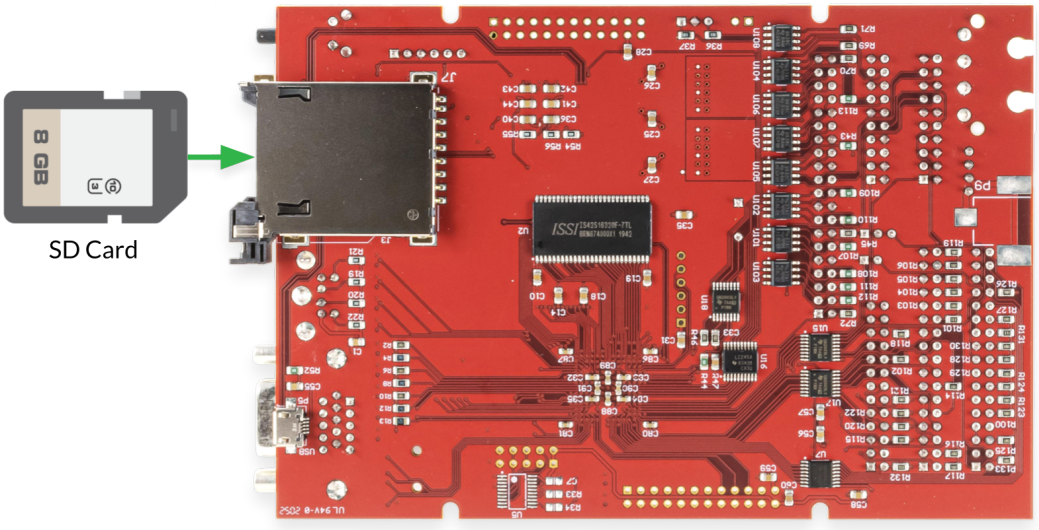


For RTC configuration remove SD card and power on DREM. Press TAB key to select "Setup", enter the current date and time then press enter.



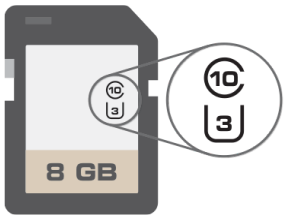
Inserting SD Card

The SD Card slot is located at the PCB bottom.



SD Card Preparation

NOTE: DREM requires industrial grade SD Card Speed Class 10 or better. Using slower/consumer grade/no name SD cards may cause intermittent errors in HDD mode.



DREM is shipped with **SanDisk 8GB Industrial MLC Grade UHS-I Class 10 SD SDHC SDSDAF3-008G** with pre-installed DREM software.

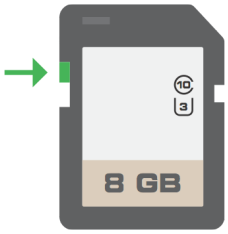
Should you need to use a different SD Card – you must prepare it for PC use in several simple steps:

1. Format SD Card and create FAT32 file system. On Windows PC:
   - insert SD Card into the card reader
   - press Windows key or click Start button
   - click Computer
   - right click SD Card
   - click Format...
   - select FAT32 File System
   - click Start

NOTE: DREM supports FAT long file names.

2. Copy software and configuration files
   - copy files **config.ini** and **drem2.ini** to SD Card root directory
   - create **DREM** folder on SD Card
   - copy files **soc.bit** and **drem.bin** to SD Card **DREM** folder

3. Copy desired DSK and CFG files to SD Card



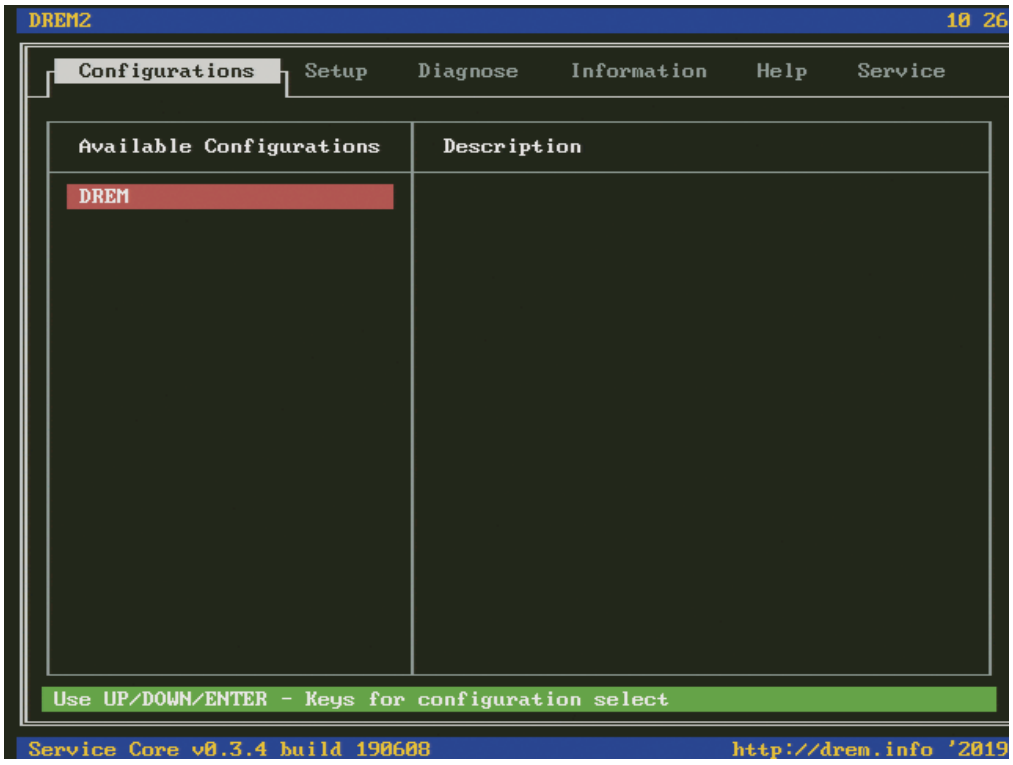
NOTE: SD card content **MAY NOT** be protected using SD Card lock switch. Use file attributes and/or CFG file options for write protection.

SD Card root directory must contain file **config.ini**

DREM default **config.ini** file content:

```
[DREM]
bitstream = DREM/soc.bit
rom = DREM/drem.bin,0x00000,0
spimaster = fpga
button = fpga
autostart = yes
```

Should the line *autostart* be removed or set to "*no*" - DREM will present a power-up boot menu where you'll be able to select the required configuration.



4. Edit DREM configuration file **/drem2.ini**

This file contains DREM startup configuration. If this file is missing DREM assume default values same as per default **drem2.ini** file below:

```
[start-up]
start log                       = NO
start menu                      = NO

[keyboard]
type                            = QWERTY
repeat delay (ms)               = 250
repeat rate (ms)                = 65
beep                            = NO

[mouse]
enabled                         = NO
sensitivity                     = 1

[button]
double click (ms)               = 125
double click delay (ms)         = 250
hold (ms)                       = 1000
```



```
[log]
console                         = YES
sync timeout (sec)              = 2
timestamp                       = NO

[debug]
sd card                         = NO
rlv interface                   = NO
main fsm                        = NO
disk write events               = NO
write errors only               = NO
write payload                   = YES
drive                           = ALL
track                           = ALL
write event occurrence          = ALL

[cache]
l2 preload                      = YES
l2 preload timeout (sec)        = 5
l2 idle sync timeout (sec)      = 10
l2 ds sync timeout (sec)        = 5
ram optimization                = PERFORMANCE
ram allocation order            = 0123ABCD

[file manager]
enabled                         = YES
timeout (sec)                   = 20
show system files               = NO
show hidden files               = NO
dsk file extensions             = DSK DW ADF MD AIM LVT

[drive info]
timeout (sec)                   = 20

[drive map]
timeout (sec)                   = 120

[menu]
enabled                         = YES
timeout (sec)                   = 20
restart from top level          = YES
exit enabled                    = YES
status line enabled             = YES
mnu file                        = /ROOT.MNU

[auto snapshot]
create every (min)              = 0

[fdd interface]
```

```
cable type                      = STRAIGHT
default type                    = SHUGART

[hard drive 0]
enabled                         = YES
dsk file                        = /DEFAULT0.DSK
data connector                  = 0
head sound enabled              = NO

[hard drive 1]
enabled                         = YES
dsk file                        = /DEFAULT1.DSK
data connector                  = 1
head sound enabled              = NO

[hard drive 2]
enabled                         = YES
dsk file                        = /DEFAULT2.DSK
data connector                  = 2
head sound enabled              = NO

[hard drive 3]
enabled                         = YES
dsk file                        = /DEFAULT3.DSK
data connector                  = 3
head sound enabled              = NO

[floppy drive a]
enabled                         = YES
dsk file                        = /DEFAULTA.DSK
head sound enabled              = NO

[floppy drive b]
enabled                         = YES
dsk file                        = /DEFAULTB.DSK
head sound enabled              = NO

[floppy drive c]
enabled                         = YES
dsk file                        = /DEFAULTC.DSK
head sound enabled              = NO

[floppy drive d]
enabled                         = YES
dsk file                        = /DEFAULTD.DSK
head sound enabled              = NO
```

DREM2.INI File Sections and Key / Value Pairs

[Start-Up]

Start Log	Open log file on startup. Possible values: **YES, NO** (Default)
Start Menu	Open menu on startup. Possible values: **YES, NO** (Default)

[Keyboard]

Type	Possible values: **QWERTY**(Default), **AZERTY**
Repeat Delay (ms)	Possible values: **30..300** ms. (Default 250 ms.)
Repeat Rate (ms)	Possible values: **30..300** ms. (Default 65 ms.)
Beep	Possible values: **YES, NO** (Default)

[Mouse]

Enabled	Possible values: **YES, NO** (Default)
Sensitivity	Possible values: **1..16** (Default 1)

[Button]

Double Click (ms)	Possible values: **1..255** ms. (Default 125 ms.)
Double Click Delay (ms)	Possible values: **1..10000** ms. (Default 1000 ms.)
Hold	Possible values: **1..255** ms. (Default 250 ms.)

[Console]

Paper Color	Default **LIGHTBLUE**
Ink Color	Default **WHITE**
Error Ink Color	Default **LIGHTRED**
Help Ink Color	Default **YELLOW**
	Possible values: **BLACK, BLUE, GREEN, CYAN, RED, MAGENTA, BROWN, GRAY, LIGHTGRAY, LIGHTBLUE, LIGHTGREEN, LIGHTCYAN, LIGHTRED, LIGHTMAGENTA, YELLOW, WHITE**

[Log]

Console	Only error messages will be displayed on the console screen and saved to a log file if set to **NO**. Possible values: **YES**(Default), **NO**

Sync Timeout (sec)	Log sync to SD card every **1..60** sec. (Default 2 sec.)
Timestamp	Possible values: **YES, NO** (Default)

[Debug]

Main FSM	DREM Codec management debug output. Possible values: **YES, NO** (Default)
SD Card	Enable SD Card CID, CSD, Status debug output. Possible values: **YES, NO** (Default)
RLV Interface	Enable DEC RLV Command/Status debug. Possible values: **YES, NO** (Default)
Disk Write Events	Enable debug output for write operations. Possible values: **YES, NO** (Default)
Write Errors Only	Enable debug output only for write errors. Possible values: **YES, NO** (Default)
Write Payload	Enable payload output for write debug operations. Possible values: **YES**(Default)**, NO**
Drive	Drive number for **[Debug] Disk Write Events**. Possible values: **ALL**(Default), **0..7**
Track	Track number for **[Debug] Disk Write Events**. Possible values: **ALL**(Default), **0..2047**
Write Event Occurrence	Write event occurrence for **[Debug] Disk Write Events**. Possible values: **ALL**(Default), **0..32767**

[Cache]

RAM Optimization	Possible values: **PERFORMANCE**(Default)**, SIZE**
RAM Allocation Order	RAM allocation and L2 preloading order. Possible values: string of 8 characters **0123ABCD**(Default)
L2 Preload	Enable L2 cache preload. Possible values: **YES** (Default)**, NO**
L2 Preload Timeout (sec)	L2 cache preload start/restart if drive is idle for **1..360** sec. (Default 3 sec.)
L2 Idle Sync Timeout (sec)	L2 cache sync to SD card if the drive is idle for **0..60** sec. (Default 10 sec.)
L2 DS Sync Timeout (sec)	L2 cache sync to SD card if the drive is not selected for **0..60** sec. (Default 5 sec.)

[File Manager]

Enabled	Possible values: **YES** (Default)**, NO**

Timeout (sec)	Exit File Manager if inactive for **0**(=DO NOT EXIT)**1..360** sec. (Default 20 sec.)
Show System Files	Possible values: **YES, NO** (Default)
Show Hidden Files	Possible values: **YES, NO** (Default)
DSK File Extensions	Defines file types to display in File Manager. List 1, 2 or 3 characters long file extensions separated by space. Maximum 50 extensions. Default value is **"DSK DW ADF MD AIM LVT"**
[Drive Info]	
Timeout (sec)	Exit Drive Info screen if inactive for **0**(=DO NOT EXIT)**1..360** sec. (Default 20 sec.)
[Drive Map]	
Timeout (sec)	Exit Drive Map screen if inactive for **0**(=DO NOT EXIT)**1..360** sec. (Default 20 sec.)
[Menu]	
Enabled	Possible values: **YES** (Default), **NO**
Timeout (sec)	Exit Menu if inactive for **0**(=DO NOT EXIT)**1..360** sec. (Default 20 sec.)
MNU File	Full path name to MNU file. Default: **/ROOT.MNU**
restart from top level	Possible values: **YES, NO** (Default)
status line enabled	Possible values: **YES** (Default), **NO**
exit enabled	Possible values: **YES, NO** (Default)
[Auto Snapshot]	
Create Every (min)	Auto Snapshot Interval in minutes. Possible values: **0**(=DISABLED, Default), **30..525600**
[FDD Interface]	
Cable Type	Possible values: **STRAIGHT** (Default), **TWISTED**.
Default Type	Possible values: **SHUGART** (Default), **IBM-PC, AMIGA, DEC-RX50**.
[Hard Drive 0]	
Enabled	Possible values: **YES** (Default), **NO**

DSK File	Full path name to DSK file for HDD **0:**. Default: **/DEFAULT0.DSK**
Data Connector	HDD **0:** data connector routing: **0** (Default), **1,2,3**
Head Sound Enabled	Possible values: **YES, NO**(Default)

[Hard Drive1]

Enabled	Possible values: **YES** (Default), **NO**
DSK File	Full path name to DSK file for HDD **1:**. Default: **/DEFAULT1.DSK**
Data Connector	HDD **1:** data connector routing: **0, 1** (Default), **2,3**
Head Sound Enabled	Possible values: **YES, NO**(Default)

[Hard Drive 2]

Enabled	Possible values: **YES** (Default), **NO**
DSK File	Full path name to DSK file for HDD **2:**. Default: **/DEFAULT2.DSK**
Data Connector	HDD **2:** data connector routing: **0,1,2** (Default), **3**
Head Sound Enabled	Possible values: **YES, NO**(Default)

[Hard Drive 3]

Enabled	Possible values: **YES** (Default), **NO**
DSK File	Full path name to DSK file for HDD **3:**. Default: **/DEFAULT3.DSK**
Data Connector	HDD **3:** data connector routing: **0,1,2,3** (Default)
Head Sound Enabled	Possible values: **YES, NO**(Default)

[Floppy Drive A]

Enabled	Possible values: **YES** (Default), **NO**
DSK File	Full path name to DSK file for FDD **A:**. Default: **/DEFAULTA.DSK**
Head Sound Enabled	Possible values: **YES, NO**(Default)

[Floppy Drive B]

Enabled	Possible values: **YES** (Default), **NO**
Load B	Full path name to DSK file for FDD **B:**. Default: **/DEFAULTB.DSK**
Head Sound Enabled	Possible values: **YES, NO**(Default)

[Floppy Drive C]

Enabled	Possible values: **YES** (Default), **NO**

DSK File	Full path name to DSK file for FDD **C:**. Default: **/DEFAULTC.DSK**
Head Sound Enabled	Possible values: **YES, NO**(Default)

[Floppy Drive D]

Enabled	Possible values: **YES** (Default)**, NO**
DSK File	Full path name to DSK file for FDD **D:**. Default: **/DEFAULTD.DSK**
Head Sound Enabled	Possible values: **YES, NO**(Default)

DSK and CFG Files

Introduction

DREM uses DSK disk image files, which contain the raw dump of a disk. A raw image consists of a sector-by-sector binary copy of the source medium. Since DSK files hold no additional data beyond the disk contents, DREM uses an additional CFG file to obtain the disk geometry and encoding information.

Raw disk image files may have many different extensions i.e. IMG, ADF, DW etc. When downloading disk image files from internet collections it is important to understand the difference between headerless raw disk images and other file types and use the appropriate CFG file. A user may select one of the CFG files supplied with DREM or create a new one.

Upon selection of a DSK file DREM will search for a CFG file in the following order:

- Same name as DSK file, but CFG extension in the same directory as DSK file
- **DEFAULT.CFG** in the same directory as DSK file
- **DEFAULT.CFG** in the root directory

This provides an easy and efficient way of organizing DSK file collections on an SD Card.

DSK Files

In most cases DREM utilizes standard raw image files as described in this section. For controllers that use proprietary ECC48 or ECC56 DREM utilize special file format, please see the next section for details.

A raw image consists of a sector-by-sector binary copy of the source medium. A file size is equal to the formatted media capacity of certain geometry:

FileSize = #OfTracks * #OfSides * #OfSectorsPerTrack * SectorSize

For instance for IBM PC MS DOS 3”5 1.40 MB disk

80 tracks * 2 sides * 18 sectors per track * 512 bytes per sector = 1,474,560 bytes

Bytes are stored in the following order:

```
Track 0 Side 0
Sector 0, Sector 1 ….  Sector N
Track 0 Side 1
Sector 0, Sector 1 ….  Sector N
....
Track 0 Side N
Sector 0, Sector 1 ….  Sector N
```

```
Track 1 Side 0
Sector 0, Sector 1 ….  Sector N
....
Track N Side N
Sector 0, Sector 1 ….  Sector N
```

Disk image files may have different file extensions: DSK, IMG, ST, ADF, DW etc. Despite this, they have the same internal structure. DREM will allow you to “insert” into virtual drive files with various extensions, but in this manual we will refer to disk image files as DSK files. There are too many different disk image file extensions, which usually reflect the host computer type. Should you have trouble selecting a file with DREM file manager – try to change its extension to DSK.

TIP: An IMZ file is an IMG file that has been compressed with gzip. The typical file extension is ".imz", derived from ".img.gz". To use it with DREM unzip it and change its extension to DSK.

TIP: An ADZ file is an ADF file that has been compressed with gzip. The typical file extension is ".adz", derived from ".adf.gz". To use it with DREM unzip it and change its extension to ADF.

Creating and resizing DSK files using DREM

DREM provides convenient functions for creating/resizing DSK files according to CFG file specifications.

First you need to create CFG file with desired number of Tracks/Sectors/Sector Size, pair it with arbitrary DSK file and assign it to DREM virtual drive using **DREM2.INI** Now you may power up DREM and enter Drive Info mode by pressing appropriate drive button (**0123ABCD**). DSK file size error message will be displayed. In order to adjust DSK size press **Ctrl+S** this function will expand or truncate DSK file according to CFG specification.

Pressing **Ctrl+C** creates DSK template file in SD card root directory with the descriptive filename:

```
/DSK Template 80x2x18 x 512 - 24 Oct 2019 09-40-36.dsk
```

Creating and resizing DSK files using PC

An empty DSK file may be created using a Windows PC by starting *Command Prompt* and issuing command:

```
fsutil file createnew <name of file> <size in bytes>
```

for example:

```
fsutil file createnew msdos.dsk 1474560
```

NOTE: *fsutil* requires *Run as administrator* when you starting *Command Prompt*

Some DSK files downloaded from the Internet may be smaller than full device DSK image. You may adjust file size using command:

```
fsutil file seteof <name of file> <size in bytes>
```

DSK Files for proprietary ECC48 and ECC56

Some RLL controllers use proprietary ECC48 or ECC56 polynomials for data fields, so ECC can not be computed and must be stored in file along with sector data. Therefore a slightly bigger **DSK** file must be created: 48/8 = 6 extra bytes or 56/8 = 7 extra bytes per sector are needed.

FileSize = #OfTracks * #OfSides * #OfSectorsPerTrack * (SectorSize + ECC Bytes)

For instance for ST138R disk with ACB adapter:

615 tracks * 4 sides * 26 sectors per track * (512 + 6) bytes per sector = 33,131,280 bytes

Or for JVC JD-3824T0Z0 disk with SMS-OMTI Epron Equity LT adapter:

615 tracks * 2 sides * 34 sectors per track * (512 + 6) bytes per sector = 21,662,760 bytes

For that reason low level format must be executed first in order to store initial ECC values for all sectors.

NOTE: This type of **DSK** files can not be used directly with other systems, like software computer simulators. Conversion to regular raw image **DSK** is possible with a simple script by dropping ECC bytes. Reverse conversion is not possible.

Performance Considerations

DREM power up boot time is 7 sec., which is much faster than real HDD spin up time (i.e. Seagate ST-251 power up to ready time is 17 sec.)

DREM read/write operations are, on average, 50% faster than real HDD.

Memory Allocation

Total memory available for disk cache allocation is 126 Mb. First 30 Mb in the same bank as software so it is somewhat slower than the remaining 96Mb. **DREM2.INI** options provide control on startup memory allocation.

```
[Cache]
RAM Optimization=PERFORMANCE  ; SIZE = 126Mb, PERFORMANCE = 96Mb
RAM Allocation Order=0123ABCD
```

DREM will try to distribute all available memory between drives configured in **DREM2.INI** Memory allocation information is printed on the console screen and saved into the log file. Additionally **CFG** file options:

```
L1 Size=<number of tracks>
L2 Size=<number of tracks>
```

are used for manual memory allocation of specific drives.

Disk Geometry

Always choose more tracks and less heads for the given HDD size. A 1024 track and 2 head drive will work faster than a 512 track and 4 head HDD, which works faster than a 256 track and 8 heads HDD. Always go for the maximum number of tracks supported by a given controller and then increase the number of heads to achieve the desired drive capacity. The reason behind performance variations is that DREM has to deliver the whole cylinder on host seek requests. Larger cylinder size - more time is required to generate the LLF cylinder. Also, smaller cylinders promote better cache performance since RAM may hold a larger number of smaller units. For the same reason, RLL drive emulation, in general, is slower than MFM drive emulation.

Simultaneous FDD and HDD emulation

DREM is capable to emulate FDD and HDD at the same time, however, some limitations apply:

- Single task operating system
- HDD controller with “auto deselect” feature

This is true for most real life MFM/RLL HDD applications. Simultaneous FDD and HDD have been tested on PC DOS with 14 different types of HDD controllers (see Appendix 6) and on DEC PDP with RQDX3. DEC RLV12 has no “auto deselect” feature, in such a case a second DREM is required for FDD simulation.

TIP: Some HDD controllers may be configured for “auto deselect” using configuration jumpers.

CFG Files

CFG files are used to define:

- Interface Type and Properties
- Low Level Format Type and Properties
- Disk Image File Type

FD/HDD Low Level Format(LLF) is either proprietary or standard. Proprietary LLF's (i.e. Amiga) have a well known fixed structure, standard LLF's are IBM System 34/ISO 9529/ECMA-125 based and DREM comes with CFG files for many popular systems using it. Therefore, in most cases, there is no need for CFG file customization. Customization is usually done by fine tuning ISO type LLF's.

Ready to use CFG files are provided for the following systems:

FDD

- Agath 840K (DSK and AIM)
- AMIGA (drive identification supported)
- DEC 8in RX01/RX02 Compatible Controllers (FM and M2FM)
- DEC RX50, RX33
- DVK MX
- E-Mu Emulator II+ HD
- Elektronika BK, MC-0511 (aka UKNC)
- Heathkit H17
- HP-86A (HP 9130A)
- HP 9153 A/B/C
- ISO, IBM (any possible sector size)
- KR1801VP1-128 based: DVK MY
- Lvov PK-01 (DSK and special virtual disk modes for LVT files)
- Nemiga MD (DSK and MD)
- NeXT
- Northstar Advantage

DEC 8in RX01/RX02 Compatible Controllers (FM and M2FM):

- AED FLEX0
- Data Systems Design DSD4140
- Dilog DQ419
- Micro Development Associates MDS MXV21
- Sigma Information Systems SDC-RXV21 SDC-RXV31

HDD

- Adaptec ACB-4000 (E-Mu Emulator II+HD, Atari SH204, Kearney & Trecker 1015 + Gemini D CNC control)
- Adaptec MFM ACB-2010A
- Adaptec RLL ACB-2372B
- Adaptec RLL ACB-2070A
- Adaptec RLL ACB-4070 and compatible (Atari Megafile)
- Advanced Digital Corp. HDC-1001
- Bostomatic 312 + SPC-II Controller
- Compupro Disk 3
- Convergent Technologies AWS SA-1000
- Corvus H Drive
- Data General DG/20
- DEC Pro-3xx RD
- DEC RQDX3(PDP, MicroVAX), RLV
- Dilog DQ614
- DTC WD1010 compatible controllers
- DTC WD2010 compatible controllers (i.e. DTC-7180)
- DTC-5160 RLL
- DVK DW
- Elektronika MC-0585 (aka Elektronika 85) RD
- IBC MMC
- IBM 1501492 (XEBEC)
- IBM 5170 WD1010 , PC JX (WDC1010A) compatible controllers
- Intel 8206 and 82062 based controllers (WD2010 compatible)
- Heathkit H17
- Heathkit Z-217
- Kaypro 10
- L/F Technologies 8000 + LFT HDC 1100
- NCL NDC
- NEC-16T (PC-9800)
- Neve Mixing Console (GML Idris)
- Northstar Advantage
- Perstor Systems Inc. ADRC9008 (ARRL 9 Mbps)
- Poisk-1 B942
- SMC HDC9234 based controllers(TI-99/4 Myarc HFDC)
- Seagate ST11M MFM, Seagate ST11R, ST-21R, ST-22R RLL
- SMS OMTI Series 5510, 5000 and 20 (AMIGOS / PROMIGOS)
- SMS FWD8006 HDD+FDD Multibus
- Western Digital WD1010 based controllers (any sector size, CRC16)
- Western Digital WD2010 based controllers (any sector size, CRC16 and ECC32)
- Western Digital WD5010 based controllers (any sector size, CRC16 and ECC32)
- Western Digital WD5011 based controllers (any sector size, CRC16 and ECC32, ECC56 RLL)
- Western Digital WD50C12 based controllers (any sector size, CRC16 and ECC32, ECC56 RLL)
- Xebec
- Xerox Rigid Disk
- 26pin JVC-SMS OMTI hard sectored (EPSON Equity LT)

The CFG files are simple ASCII encoded text files with a basic structure composed of sections, keys, and values. The basic element contained in a CFG file is the key. Every key has a name and a value, delimited by an equals sign (=). The name appears to the left of the equals sign.

```
name=value
```

Keys are grouped into arbitrarily named sections. The section name appears on a line by itself, in square brackets ([and]). All keys after the section declaration are associated with that section. There is no explicit "end of section" delimiter; sections end at the next section declaration, or the end of the file. Sections may not be nested.

```
[section]
a=a ; comment
b=b
```

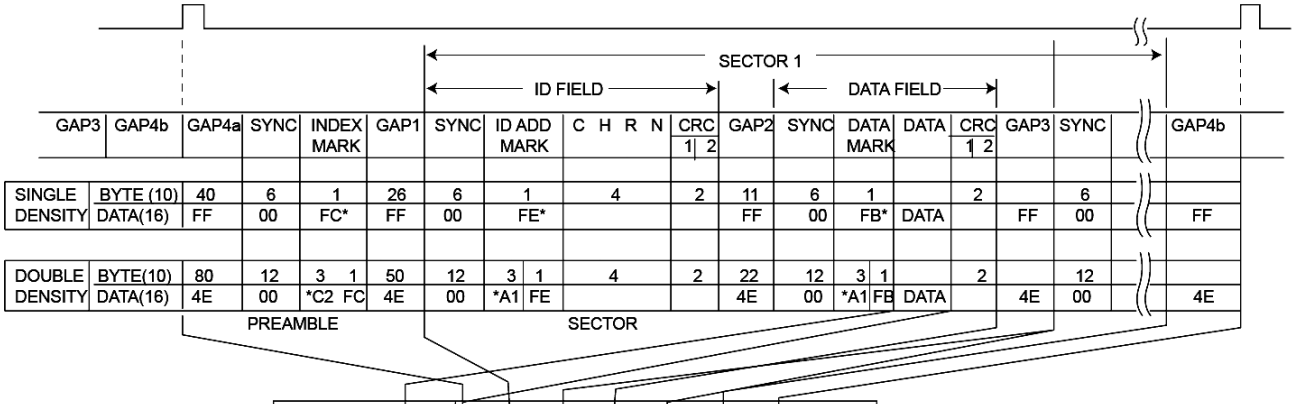
Section and key names are not case sensitive. Blank lines are ignored. Leading and trailing whitespace around the outside of the key name is ignored. Comment lines start with ; sign. The order of properties in a section and the order of sections in a file is irrelevant. The second occurrence of a key name overrides the first occurrence (with the first value discarded).

Example of CFG file for IBM PC MS DOS 3”5 1.44Mb FDD

```
[DSK]
Name=PC 3"5 1.44M
Format=ISO
Encoding=MFM
Bitrate=500
Tracks=80
Sides=2
Sectors=18
First Sector ID=1
Sector Size=512
```

Once a CFG file is loaded, DREM will validate the DSK file size against the CFG configuration using formula FileSize = #OfTracks * #OfSides * #OfSectorsPerTrack * SectorSize. A warning will be issued if the DSK file size does not match the calculated value.

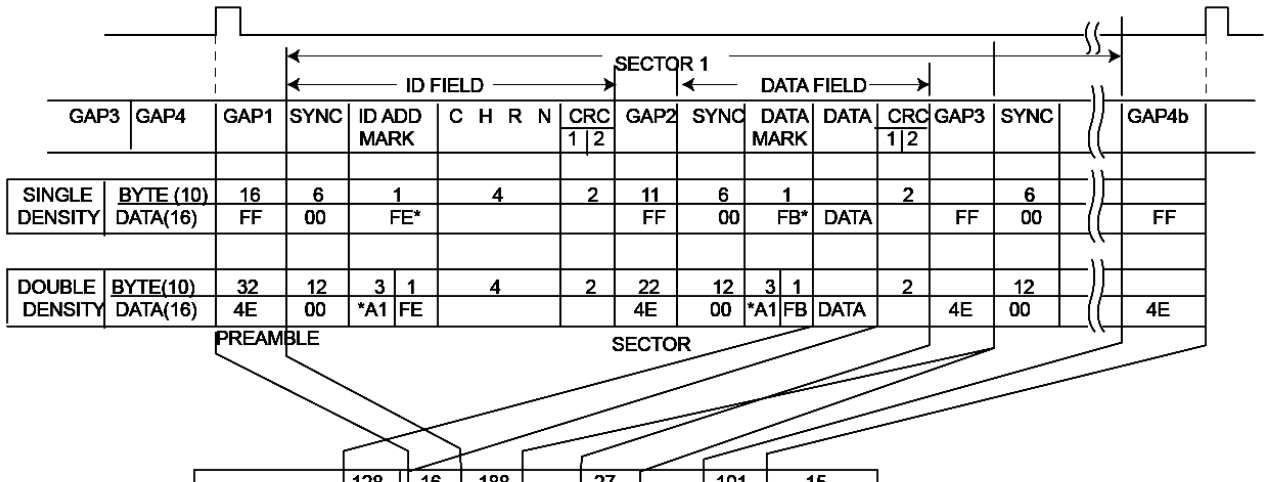
All LLFs’ general structures are quite similar. IBM System 34 LLF has maximum elements. All other LLFs have fewer elements. Unfortunately, standards do not define elements’ names explicitly, so it is important to establish a naming convention and understand the LFF structure before attempting CFG file customization. The DREM CFG file uses the following GAP naming convention:



SINGLE DENSITY(10)	128	73	188		27		232	15
	256	73	331		42		73	9
	512	73	603		58		540	4
DOUBLE DENSITY(10)	256	146	372		54		152	15
	512	146	658		84		182	9
	1024	146	1202		116		1296	4
	DATA				GAP3		GAP4	SECTOR/ TRACK

	SINGLE DENSITY		DOUBLE DENSITY	
	DATA	CLOCK	DATA	CLOCK
INDEX ADDRESS MARK	FC	D7	FC, F1	14,01
ID ADDRESS MARK	FE	C7	A1, FE	0A, 00
DATA ADDRESS MARK	F8	C7	A1, F8	0A, 00
SELECTED DATA ADDRESS MARK	F8	C7	A1, F8	0A, 03
GAP	FF	FF	4E	90
SYNC	00	FF	00	FF
INDEX MARK	-	-	C2	14
ADDRESS MARK	-	-	A1	0A

For example ISO LLF has no GAP4a or INDEX MARK elements, so GAP4a is not an applicable option for ISO LLF.



SINGLE DENSITY(10)	128	16	188		27		101	15
	256	16	331		42		130	9
	512	16	603		58		94	5
DOUBLE DENSITY(10)	256	32	372		54		266	15
	512	32	658		84		296	9
	1024	32	1202		116		208	5
	DATA				GAP3		GAP4	SECTOR/ TRACK

CFG File Key / Value pairs

Name Descriptive configuration name. String 32 characters maximum. Longer strings will be truncated.

Interface Possible values: **SHUGART, IBM-PC, AMIGA, DEC-RX50, ST506, ST412, JVC-26PIN, DEC-RLV**.

NOTE: DREM may be configured to use one HDD Interface Type and one FDD Interface Type. All configured HDD's and FDD's must use the same Interface Type.

Format **Mandatory.** LLF Type. Possible values: **IBM**, **ISO, MX, MD, AGAT840, AMIGA, EMU, RX01, RX02, DW, ST, WDC, XEBEC, RQDX3, ACB, ACB2070A, ACB4000, ACB4070, SMS-OMTI, SMS-FWD8006, NCL, RL, HDC9234, XEROX-RIGID, BD05, CORVUS, NORTHSTAR-FDD, NORTHSTAR-HDD, NEC-UPD7261, NEC-16T, H17, DG20, PERSTOR, COMPUPRO-DISK3, LFT1100, AWS-SA1000, IBC-MCC, HEATH-Z-217, DILOG-DQ614.** See corresponding section for particular LLF details.

TIP: This is the highest priority key, which defines DREM LLF mode. LLF modifiers incompatible with mode selected will be ignored.

Write Splice Used with **Format=ISO** and **Format=IBM**. Possible values: **YES, NO** (Default). If **Write Splice=YES** then write splices (desync marks) are inserted before GAP2 and GAP3. Required for compatibility with KR1801VP1-128 based controllers: DVK MY, Elektronika BK, Elektronika MC-0511 (aka UKNC).

Write Lead Out Possible values: **YES**(Default), **NO**. If **Write Lead Out=YES** then two extra bytes is expected in every write transaction. Some rare controllers, i.e. **SMS-FWD8006**, terminate write transactions after the last CRC/ECC bit, in such case **Write Lead Out** must be set to **NO**.

RX50 LBN Used with **Format=IBM** for DEC RX50 drives. Possible values: **NATURAL, PHYSICAL** (Default).

EMU Type Used with **Format=EMU**. Possible values: **1, 2** (Default).

MX Type Used with **Format=MX**. Possible values: **OLD, NEW** (Default).

MD Type Used with **Format=MD**. Possible values: **MD, DSK** (Default). Defines DSK file type: **MD** – True sector-by-sector binary copy of Nemiga disk, **DSK** – Generic RT11 disk image without, Nemiga specific, reserved sector #0.

AGAT Type Used with **Format=AGAT840**. Possible values: **DSK** (Default), **AIM**.

AGAT Volume	Used with **Format=AGAT840**. Possible values: hexadecimal **0x01-0xFF**. Default: **0xFE**
AGAT Desync	Used with **Format=AGAT840**. Possible values: **TRUE** (Default), **SIMULATED**.
Data ECC	Used with **Format= WDC**. Possible values: **YES** (Default), **NO**.

For keys below the default values selected from the DREM LLF database. See the corresponding section for particular LLF details.

Encoding	Mandatory. Possible values: **FM, MFM**(Default), **RLL**
Bitrate	Bitrate in kbps. Possible values: **250**(Default), **310, 500, 1000, 4100, 4340, 5000, 5500, 7500, 9000.** **NOTE:** There is no definitive standard for **FM** bitrate. Some datasheets will mention payload data bitrate and some payload+sync bitrate. DREM Bitrate for **Encoding=FM** takes into account synchronization bits. I.e. for data bitrate 125kbps - **Bitrate=250**
RPM	Possible values: **150, 288, 300**(Default), **360, 600, 2597, 3000, 3600**
Tracks	**Mandatory.** Possible values: **1-2048.** Equivalent of Cylinders for HDD's
L1 Size	Possible values: **1-<Tracks>**
L2 Size	Possible values: **0**(=**AUTO** Default)-**<Tracks>**
Sides	**Mandatory.** Possible values: **1-16.** Equivalent of Heads for HDD's
Sectors	**Mandatory.** Possible values: **1-36.**
Hard Sectors	Number of hard sectors. Possible values: **1-36.**
Interleave	Possible values: **1..(Sectors-1)**. Default: 1. **NOTE:** There is no definitive standard for **Interleave**. DREM is using sector_*skip_factor = interleave -1*. For example DREM **Interleave=4** ordering the sectors like this: 1 8 6 4 2 9 7 5 3.
Track Skew	Possible values: **0..(Sectors-1)**. Default: 0.
Side Skew	Possible values: **0..(Sectors-1)**. Default: 0.
First Sector ID	**Mandatory.** Possible values: **0** or **1**.
Sector Size	**Mandatory.** Possible values: **1-65535**.
GAP4a	Possible values: **0-255**.
GAP1	Possible values: **0-255**.

GAP2	Possible values: **0-255**.
GAP3	Possible values: **0-255**.
SYNC	Possible values: **0-255**.
GAP Byte	Possible values: hexadecimal **0x00-0xFF**.
Side 1 File	Full path name to DSK file for Side one. May be used only if **Sides=1**.
Step Rate	Possible values: **0-30000** us. (microseconds) Default: **0=AUTO**.
Ready Signal	Ready Signal mode. Possible values: **ALWAYS, DRIVE-SELECT, DISK-CHANGE, SEEK-COMPLETE, AMIGA**.
RWC Signal	Reduced Write Current Signal. Defines how HDD Control Pin 2 is used: `/HD_SLCT_3 or /RWC.` Possible values: **YES, NO** (Default).
FDD Eject Signal	Defines how FDD Control Pin 1 is used. Possible values: **YES, NO** (Default).
Snapshot Enabled	Possible values: **YES, NO** (Default).
WR Protected	Possible values: **YES, NO** (Default).
L1 Sync Event	Possible values: **WRFIFO** (Default), **STEP** .

Details on DREM supported LLF's

For all LLF's:

- For given combination of **Encoding, PRM** and **Bitrate** RAW track size is calculated and displayed
- **GAP4b=AUTO** always. **GAP4b** calculated and displayed automatically
- For a given combination of **Format, GAP4a, GAP1, GAP2, GAP3, SYNC, Sectors** and **Sector Size** RAW track size is calculated. If it is bigger than the RAW track size determined by the given combination of **Encoding, PRM** and **Bitrate** then an error message is issued.

IBM / ISO

Industry standard. For use in MOST computers and appliances: IBM PC, Atari ST, DEC RX33/RX50 etc.

Valid **Encoding** FM, MFM or RLL. **GAP4a, GAP1, GAP2, GAP3, SYNC** and **GAP Byte** default values for given **Encoding** and **Sectors** are set as per Fig 7 and Fig 8. Default **RPM=300**. Default **Bitrate=250**. Default **Interface=SHUGART**. Supported **Sector Size**: 128, 256, 512, 1024, 2048, 4096.

NOTE: DEC RQDX3 floppies: RX50 and RX33, are using standard IBM/ISO LLF. DREM is capable of simulating the RX50 interface if used with Interface=DEC-RX50 (Track 0 signal is suppressed for side 1). DREM is capable of using DSK files with either NATURAL or PHYSICAL LBN order. Natural order DSK's are more common and RX50 LBN=NATURAL is default. Please see the RQDX3 section for information on LUN numbering and jumper settings.

MX

For use with DVK (Dialogue Computing Complex) - a Soviet PDP-11-compatible personal computer, with MX FDD controller.

FM, 300 RPM, 250 000 bps un-formatted track capacity 3125 bytes

Possible disk types:

5"25 40 tracks, 1 side , Sector 256 bytes, 11 sectors per track, 112640 bytes formatted capacity

5"25 40 tracks, 2 sides, Sector 256 bytes, 11 sectors per track, 225280 bytes formatted capacity

5"25 80 tracks, 1 side , Sector 256 bytes, 11 sectors per track, 225280 bytes formatted capacity

5"25 80 tracks, 2 sides, Sector 256 bytes, 11 sectors per track, 450560 bytes formatted capacity

MD

For use with Nemiga PK588 - a Soviet PDP-11-compatible personal computer,

FM, 300 RPM, 250 000 bps un-formatted track capacity 3125 bytes

5"25 80 tracks, 1 side , Sector 128 bytes, 23 sectors per track, 235 520 bytes

FDD is double sided and can access the logical volume on the other side of the floppy, so two single sided disk images may be inserted in a single virtual drive using **Side 1 File** key.

DREM supports two types of disk Nemiga images: **MD Type=MD**, **MD Type=DSK**

MD: True sector-by-sector binary copy of Nemiga disk

DSK: Generic RT11 disk image without, Nemiga specific, reserved sector #0.

Use of DSK images is very convenient for exchange with other PDP-11-compatible systems, soft emulators and accessing files with *Total Commander* "RT-11dsk" plugin.

AGAT840

For use with Agat, a series of 8-bit computers produced in the Soviet Union (partially compatible with Apple II) with 840K FDD controller.

MFM, 300 RPM, 250 000 bps

5"25 80 Tracks, 21 Sectors per track, Sector 256 bytes, 2 sides, 860160 bytes formatted capacity

Agat 840K is using non traditional synchronization sequence:

- 0xA4 with standard MFM clock
- 2mks "Desync" delay (half of MFM bit cell on 250000 bps)
- 0xFF with standard MFM clock

This causes a variable unformatted track capacity depending on the number of sync marks per track. For instance, for the standard DOS format of 21 sectors per track, unformatted track capacity

6250 bytes - 3 bytes (2.625) = 6247 loss on proprietary 2mks delays

21 sec * 2 delays per sec. * 2 mks = 84 mks per track / 4 mks per bit = 21 bit ~ 2.625 bytes lost

Has been found that it may be simulated by standard MFM encoded sequence:

- 0xA4 with clock 0x12
- 0xFF with standard MFM clock

DREM is highly flexible and designed to support both modes: **AGAT Desync=TRUE** (Default),

AGAT Desync=SIMULATED.

DREM supports two types of disk Agat images: **AGAT Type=DSK**, **AGAT Type=AIM**.

- DSK: 80 Tracks, 21 Sectors per track, Sector 256 bytes, 2 sides
- AIM: RAW unformatted with "Desync" control information

AMIGA

Please see **DREM2.INI** for connectivity options. We recommend to use Host Reset cable with AMIGA, otherwise, during the initial power up, Amiga may be not able to determine the number of floppy drives correctly. In this case, to ensure proper operation, restart Amiga OS by clicking Run -> System -> Reboot.

Supported formats: DD 880Kb and HD 1.76Mb.

DW

DEC Pro-350 RD, Elektronika MC-0585 (aka Elektronika 85) RD, DVK DW

ST

Seagate ST-11M ISA MFM and Seagate ST-11R, ST-21R, ST-22R ISA RLL

ATTENTION: For Seagate controllers set BIOS HDD Type to 0 (Not Installed)!

TIP: For ST you must execute a low level format first and then proceed to *fdisk* and *format*. Low level format may be performed using controller BIOS or *SpeedStor 6.5* by Storage Dimensions, Inc. We highly recommend using *SpeedStor* software for all types of HDD's. *SpeedStor* combines the functionality of BIOS Low Level Format, *fdisk* and *format* utilities. Used in "flawless" mode:

```
sstor /flawless
```

it decreases the total time of HDD preparation dramatically.

DTC

In MFM mode use with DTC-7180 and other DTC MFM controllers.

ATTENTION: DTC-7180 jumper W6 (Auto-Deselect Enable) must be CLOSED! For DTC-7180 set appropriate BIOS HDD Type!

***TIP*:** DTC-7180 has no BIOS LLF if you need to execute LLF use *SpeedStor 6.5* in RLL mode use with DTC-5160 and other DTC RLL controllers.

***TIP*:** DTC-5160 is not compatible with *SpeedStor* if you need to execute LLF use BIOS entry point G=C800:5

WDC / DG20

Controllers based on Western Digital Corporation chip's and compatible.

- Western Digital WD1010 based controllers (any sector size, CRC16)
- Western Digital WD2010, WD5010, WD12C00A, WD42C22A based controllers (any sector size, CRC16 and ECC32)
- Western Digital WD5011, WD50C12 based controllers (any sector size, CRC16 and ECC32, ECC56 RLL
- Intel P8206 based controllers (WD2010 compatible)

Format=DG20 is used for simulating drives with 9-16 heads.

Supported **Sector Size** : 128, 256, 512(Default), 1024

For WD1010 always set: **Data ECC=NO**

For all other WDC chips in MFM mode the default value is: **Data ECC=YES** (use ECC32 instead of CRC16 for data blocks)

This will match your controller settings in most cases, but **Data ECC=NO** is possible depending on software configuration on the host computer side.

In RLL mode this option is ignored and ECC56 is always used for data blocks.

ATTENTION: Different Western Digital controllers are known to use different **First Sector ID**. For instance for WA-6VM, WD1003-W2, WD1003-WAH and WD1006S-WAH **First Sector ID=1**, for WDXT-GEN2, WDX3 and WD1002A-27X **First Sector ID=0.**

ATTENTION: For WDXT-GEN2, WDX3 and WD1002A-27X set BIOS HDD Type to 0 (Not Installed)!

ATTENTION: For WA-6VM, WD1003-W2, WD1003-WAH and WD1006S-WAH set appropriate BIOS HDD Type!

TIP: For WDC you may skip the low level format and immediately proceed to *fdisk* and *format*.

Use “sstor /flawless” to speed up the process (see ST section for more details on *sstor* and performance considerations).

Kaypro 10

*Contributed by Steven Hirsch.

A stock Kaypro 10 uses a Western Digital 1002 HDD controller and a single 10MB MFM drive. The controller supports (3) physical drives, but OEM firmware expects only one disk attached to the second data port (middle of three) and jumpered as DS1 (of 0..3).

Using a DREM with a stock Kaypro 10 is straightforward:

1. Connect the controller data cable to HDD1_DAT port on DREM
2. CFG file for drive 1: (e.g. default1.dsk)

```
[DSK]
Name=Seagate ST212 10M
Encoding=MFM
RPM=3600
Tracks=306
Sides=4
Sectors=17
First Sector ID=0
Sector Size=512
Format=WDC
Interleave=1
```

3. DREM2.INI

```
[hard drive 0]
enabled                     = NO
dsk file                    = /DEFAULT0.DSK
data connector              = 0

[hard drive 1]
enabled                     = YES
dsk file                    = /DEFAULT1.DSK
data connector              = 1

[hard drive 2]
enabled                     = NO
dsk file                    = /DEFAULT2.DSK
data connector              = 2

[hard drive 3]
enabled                     = NO
dsk file                    = /DEFAULT3.DSK
data connector              = 3
```

The Advent TurboROM is a popular aftermarket firmware update that expands Kaypro 10 support to just about any MFM drive geometry and, optionally, accommodates a second hard drive jumpered as DS2.

Using DREM to emulate a single drive on a TurboROM equipped Kaypro 10 will require a CFG file that correctly reflects the geometry of the drive that's actually in the machine. To emulate two hard drives it is necessary to produce a pair of CFG files with appropriate geometry and remap the DREM data ports in DREM2.INI:

```
[hard drive 0]
enabled                    = NO
dsk file                   = /DEFAULT0.DSK
data connector             = 2

[hard drive 1]
enabled                    = YES
dsk file                   = /DEFAULT1.DSK
data connector             = 0

[hard drive 2]
enabled                    = YES
dsk file                   = /DEFAULT2.DSK
data connector             = 1

[hard drive 3]
enabled                    = NO
dsk file                   = /DEFAULT3.DSK
data connector             = 3
```

In this case, the middle data connector on the WD 1002 connects to the HDD0_DAT port on DREM and the rightmost connector (labeled as J1 or J3 depending on board revision) to HDD1_DAT on DREM. Due to a layout error on the WD 1002, it's often necessary to trim the nylon power connector in order to clear the data cable for the second drive.

NOTE: To run multiple hard drives on a Kaypro 10, ***booth*** drives must be initialized with one of the Advent formats. See the Turbo-ROM documentation for details. In particular, if the first hard drive is in Kaypro OEM format the second drive will not be seen by the BIOS.

NOTE: The Kaypro 10 (like all too many systems) never deselects the HDD and therefore cannot emulate floppy and hard drives simultaneously.

HDC9234

For use with SMC HDC9234 based controllers, namely TI99/4A Myarc HFDC controller. For 512 byte sectors LLF is the same as WDC, all other sector sizes will produce SMC HDC9234 specific format.

TI99/4A Myarc HFDC **CFG** file.

```
[DSK]
Name=Seagate ST124 21M
Encoding=MFM
RPM=3600
Tracks=615
Sides=8
Sectors=32
First Sector ID=0
Sector Size=256
Format=HDC9234
Interleave=11
RWC Signal=YES
```

NOTE: Myarc HFDC controller supports drives with maximum 8 heads. This is because HFDC is using the Pin 2 signal on the control interface as RWC (reduced write current) instead of the Head 2^8 select signal. HFDC may be modified to handle drives with up to 16 heads:

- Cut the trace from Pin 5 of chip U9 to Pin 5 of chip U17
- Solder a jumper from Pin 12 of U9 to Pin 5 of U17

ATTENTION: AM26L32PC chip is buggy and can cause 'quirky' system problems. If you have one of these chips it is suggested to replace it with a AM26LS32AC.

ACB

Use for Adaptec MFM and RLL controllers except ACB-2070A.

For Adaptec MFM controllers ACB-2010A and compatible, use **DSK** and **CFG** files as usual.

ATTENTION: For ACB-2010A set BIOS HDD Type to 0 (Not Installed)!

Adaptec RLL controllers ACB-2372B and compatible are special cases and **DSK** file format is different. Adaptec RLL data field ECC48 polynomial is proprietary, so ECC can not be computed and must be stored in file along with sector data (Please see DSK Files for proprietary ECC48 and ECC56 section for details).

For that reason low level format must be executed first in order to make the **DSK** file working.

Sample **CFG** and **DSK** files are provided with DREM.

ATTENTION: Adaptec ACB-2372B is very sensitive to BIOS hard drive settings. Please follow the instructions below to LLF ACB-2372B RLL drives.

sstor

- Disable controller BIOS by setting appropriate jumper (please consult controller user manual)
- Set PC BIOS hard disk type to 0 (Using PC BIOS setup or from DOS using *gsetup* by Micro Consulting Associates)
- Reboot PC
- Use *sstor /flawless*
- Set the disk type via *sstor* menu and then proceed to LLF as usual

BIOS

- Enable controller BIOS by setting appropriate jumper (please consult controller user manual)
- Set PC BIOS hard disk type to 1 (Using PC BIOS setup or from DOS using *gsetup* by Micro Consulting Associates)
- Reboot PC
- Use *nefmt* by Adaptec it provides the same functionality as Adaptec ACB-2372B BIOS formatter but may be executed from DOS with controller BIOS disabled. Or use *debug* and enter G=C800:5
- Answer all questions as usual, when prompter “Allow a spare sector for defects” answer NO. Should you answer yes the resulting DSK will work OK but you will waste one sector per track per side.
- Before executing *fdisk* set BIOS hard disk type to one matching your disk track number and reboot your PC again.

Adaptec ACB-2372B does not have “auto deselect” feature. Second DREM must be used for FDD simulation.

ACB2070A

Used for Adaptec ACB-2070A and compatible.

ATTENTION: For ACB-2070A set BIOS HDD Type to 0 (Not Installed)!

NOTE: ACB-2070A maximum number of tracks is 1024.

TIP: For ACB-2070A you may skip the low level format and immediately proceed to *fdisk* and *format*. Use “sstor /flawless” to speed up the process. Important: use *SpeedStor 6.03* with ACB-2070A controllers. Reboot your PC if you have started *SpeedStor 6.5*, 6.03 will not work after running 6.5.

***TIP*:** BIOS format routine may be started using *debug* and typing G=C800:CCC

SMS-OMTI

Used for SMS OMTI MFM controllers series 5510, 5000 and 20. OMTI controllers are commonly used in external Amiga MFM HDD's AMIGOS and PROMIGOS. Please make sure that jumper configuration for number of tracks, sector size, number of sectors correspond to the **CFG** file used.

ATTENTION: For use with IBM PC set BIOS HDD Type to 0 (Not Installed)!

***TIP*:** You may skip the low level format and immediately proceed to *fdisk* and *format*. *SpeedStor* will not always work with SMS controllers. Should you need to execute low level format, then start BIOS format routine using *debug* and typing G=C800:6

In RLL mode SMS-OMTI is used with 26pin RLL controllers like one found in the EPSON Equity LT laptop. SMS-OMTI data field ECC48 polynomial is proprietary, so ECC can not be computed and must be stored in file along with sector data (Please see DSK Files for proprietary ECC48 and ECC56 section for details). For that reason low level format must be executed first in order to make the **DSK** file working. Sample **CFG** and **DSK** files are provided with DREM.

***TIP*:** EPSON Equity LT BIOS format routine may be started using *debug* and typing G=C800:7

EPSON Equity LT **CFG** file. Please note 17 hard sectors per 34 soft sectors, 2597 RPM and 518 byte sector size.

```
[DSK]
Name=SMS OMTI5055 HLO-C1
Encoding=RLL
RPM=2597
Tracks=615
Sides=2
Sectors=34
Hard Sectored=17
First Sector ID=0
Sector Size=518
Format=SMS-OMTI
Interleave=1
Interface=JVC-26PIN
```

XEBEC (IBM 1501492)

Controllers based on XEBEC chip set.

```
[DSK]
Name=XEBEC ONLY
Encoding=MFM
RPM=3600
Tracks=306
Sides=4
Sectors=17
First Sector ID=0
Sector Size=512
Format=XEBEC
Interleave=1
```

TIP: For XEBEC you may skip the low level format and immediately proceed to *fdisk* and *format*. Use "sstor /flawless" to speed up the process. Important: use *SpeedStor 6.03* with XEBEC controllers. Reboot your PC if you have started *SpeedStor 6.5*, 6.03 will not work after running 6.5.

IBM 5170

LLF is not required. IBM 5170 does not have "auto deselect" feature. Second DREM must be used for FDD simulation.

```
[DSK]
Name=Seagate ST124 21M
Encoding=MFM
RPM=3600
Tracks=615
Sides=4
Sectors=17
First Sector ID=1
Sector Size=512
Format=WDC
Interleave=1
```

ATTENTION: For IBM 5170 set appropriate BIOS HDD Type!

Everex

Everex EV-346 MFM HDD + FDD controller does not have “auto deselect” feature. Second DREM must be used for FDD simulation.

```
[DSK]
Name=Seagate ST124 21M
Encoding=MFM
RPM=3600
Tracks=615
Sides=4
Sectors=17
First Sector ID=1
Sector Size=512
Format=WDC
```

ATTENTION: For Everex set appropriate BIOS HDD Type!

HFC

HFC MFM HDD + FDD Cirrus Logic CL-SH260 based controller.

```
[DSK]
Name=Seagate ST124 21M
Encoding=MFM
RPM=3600
Tracks=615
Sides=4
Sectors=17
First Sector ID=1
Sector Size=512
Format=WDC
```

ATTENTION: ***For HFC set appropriate BIOS HDD Type!***
Use in dual HDD configuration or disable second HDD in DREM2.IN by setting:

```
[hard drive 0]
enabled                         = YES

[hard drive 1]
enabled                         = NO

[hard drive 2]
enabled                         = NO

[hard drive 3]
enabled                         = NO
```

Longshine

Longshine LCS-6620TX does not have “auto deselect” feature. Second DREM must be used for FDD simulation.

```
[DSK]
Name=Seagate ST124 21M
Encoding=MFM
RPM=3600
Tracks=615
Sides=4
Sectors=17
First Sector ID=1
Sector Size=512
Format=WDC
Interleave=9
```

ATTENTION: For Longshine set appropriate BIOS HDD Type!

ACB4000 (E-Mu Emulator II+HD)

Adaptec ACB-4000A SCSI controller. DSK and CFG files are provided for all ACB-4000A supported formats.

Sector Size	Interleave	Sectors	Tracks
256	1	32	Variable
256	>1	33	Variable
512	1	17	Variable
512	>1	18	Variable
1024	1	9	Variable
1024	>1	9	Variable

E-Mu Emulator II+HD *OS3.1HD* format is:

```
[DSK]
Name=20Mb 612 + 1 TR
Encoding=MFM
RPM=3600
Tracks=613
Sides=4
Sectors=18
First Sector ID=0
Sector Size=512
Format=ACB4000
Interleave=2
RWC Signal=YES
```

Geometry metadata is encoded according to the CFG file. DREM supports ACB-4000A sector level defect skipping feature. One extra track must be added to DSK/CFG files for storing defect list data.

NOTE: Install **R - PU** jumper on ACB-4000A (Write Precompensation turned off for both drives)

***TIP*:** Clean defect list on host system before formatting for better performance.

***TIP*:** E-Mu Emulator II+HD OS file system is stateless, therefore it is possible to safely hot-swap DSK images on DREM without rebooting E-Mu Emulator (just like floppy disks).

***TIP*:** EMXP software may be used for managing E-Mu DSK images using PC

Atari Megafile

Depending on the model Atari Megafile is using either Adaptec ACB-4070 controller or Atari ACB-4070 clone. Example of CFG file for Megafile:

```
[DSK]
Name=820x16
Encoding=RLL
Bitrate=7500
RPM=3600
Tracks=820
Sides=6
Sectors=26
First Sector ID=0
Sector Size=512
Format=ACB4070
Interleave=1
```

NOTE: Atari Megafile proprietary ST-412 Auto Sense feature is not supported! Please use **WINCAP** file in order to define drive geometry for **HDX.PRG** utility.

In order to install an emulated drive:

- Prepare floppy disk with Atari HDD utilities
- Use **CFG** file example provided
- Change Tracks and Sides values in order to emulate different drives. Do not change other values.
- Create **DSK** file of Tracks * Sides * 26 * 512 bytes
- Edit **WINCAP** file. Copy an example line and change hd#, cl# and sp# values. For example for **CFG** file above:

  ```
  62Mb:mn=820x6x26:md#0:hd#6:cy#820:pt=20-20-20-20:sp#26:dp#0x6333:
  ```

- Low Level Format and Partitioning: Run **HDX.PRG** Click *Disk*, click *Format*, click *OK*, select drive unit and click *OK*, select geometry **820x6x26** and click *OK* (Menu for geometry selection will appear only if you have proper **WINCAP** file configured) On the next screen for much faster format select “do not mark bad sectors” - click *No* and finally click *OK* to format disk.
- Restart computer
- Run **AHDI.PRG**
- Installing logical drives: Select any drive on the desktop, click *Options*, click *Install Disk Drive...*, enter desired letter, click *Install*. Repeat this step for every HDD partition.
- Installing HDD driver: Run **HINSTALL.PRG** Click *File*, click *Install*, click *C:*, click *OK*, click *OK*
- Restart computer

RQDX3

NOTE: Format=RQDX3 is used for DEC RDxx HDD's only. For RQDX3 attached floppies RX33/RX50 see IBM/ISO section.

DEC M7555 RQDX3 support only fixed number of HDD geometry configurations: RD31, RD32, RD33, RD51, RD52 30-21721-02, RD52 30-23227-02, RD53, RD54. So, for your convenience, DREM is supplied with DSK and CFG files for all of it.

DREM has built in RD drive geometry and an XBN database. Press **Alt+B** in Console Mode for printing the RD database.

```
==============================DEC RDxx geometry================================
    Drives    DEC Type           Tracks       Sides     Sectors    Sector Size
==============================================================================
              RD51                 306           4          18            512
              RD52 30-21721-02     512           8          17            512
              RD52 30-23227-02     645           7          17            512
              RD53                1024           8          17            512
              RD31                 615           4          17            512
           2: RD54                1225          15          17            512
              RD32                 820           6          17            512
              RD33                1170           7          17            512
==============================================================================
```

Drive loading sequence:

1. Test CFG for valid RD geometry
2. Test DSK for valid XBN's
    a. XBN found: test if CFG and XBN geometry is the same
    b. XBN not found: test DSK for valid SIMH footer
        i. SIMH footer found: test if CFG and SIMH geometry is the same
            1. geometry is the same: import SIMH file into RQDX3 DSK

NOTE: Older versions of SIMH do not append file footers. If you have an older SIMH file - attach it once using the latest SIMH version in order for the proper footer to be installed.

Example of successful RQDX3 DSK loading sequence:

```
Drive 2: Reading CFG ... /DEFAULT2.CFG found.

==================================CFG File====================================
[DSK]
Name=RD54 - Maxtor XT2190
Encoding=MFM
RPM=3600
Tracks=1225
```

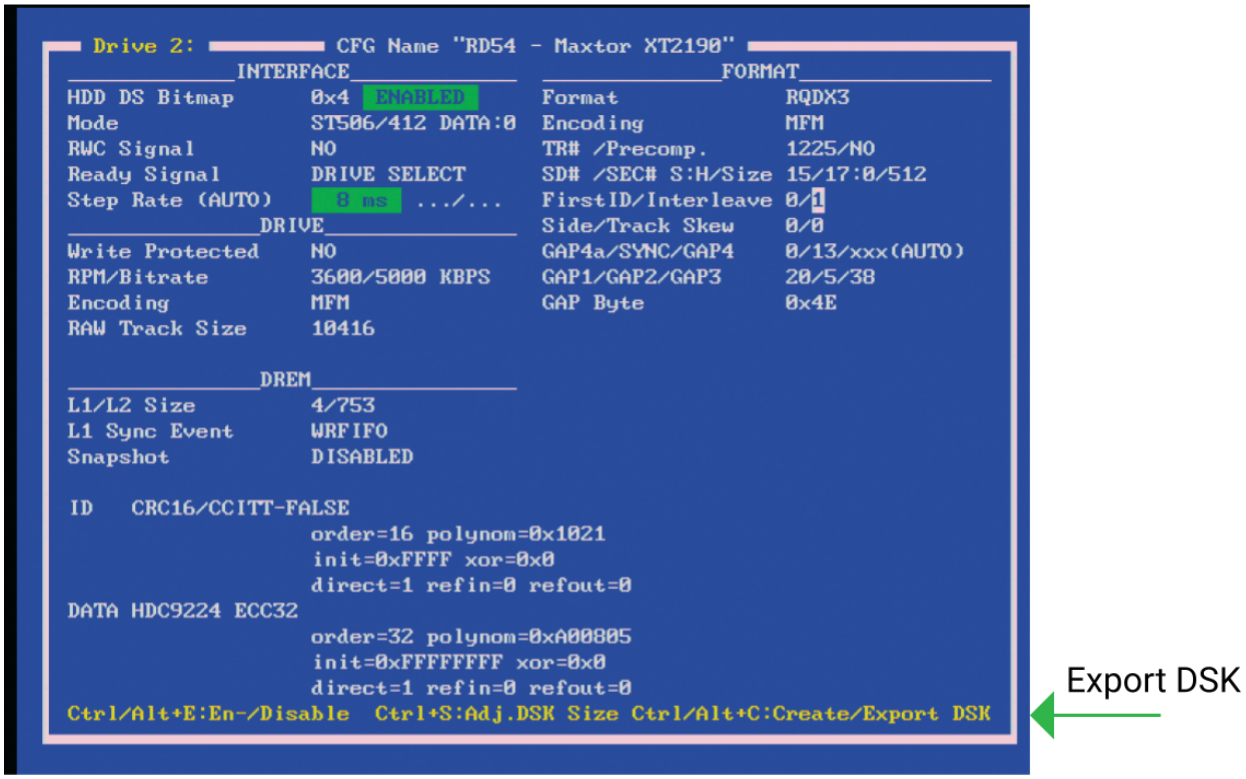
```
Sides=15
Sectors=17
First Sector ID=0
Sector Size=512
Format=RQDX3
Interleave=1
================================================================================

RD DSK Validation: CFG-RD54

XBN TR:0 SEC:00 Signature-OK CRC-OK
   Media ID     DURD54    XBN Size            54    GAP0                16
   Tracks         1225    DBN Size           201    GAP1                16
   Sides            15    LBN Size        311256    GAP2                 5
   Sectors          17    RBN Size           609    GAP3                40
   Interleave        1    RCT Size             7    SYNC                13
   Side Skew         2    RCT Number           8    Step Rate          525
   Track Skew        8    MSCP Cyl/Unit        1    CRC or ECC           1
   WR Precomp. TR 1225    MSCP Groups/Cyl      1    Max Bad Spots/Side  32
   RWC Track      1225    MSCP Tracks/Group    1    Bad Spot Tolerance 105
   Auto Recall TR 1225    Auto Recall TR 2  1226

XBN TR:0 SEC:01 Signature-OK CRC-OK
   Media ID     DURD54    XBN Size            54    GAP0                16
   Tracks         1225    DBN Size           201    GAP1                16
   Sides            15    LBN Size        311256    GAP2                 5
   Sectors          17    RBN Size           609    GAP3                40
   Interleave        1    RCT Size             7    SYNC                13
   Side Skew         2    RCT Number           8    Step Rate          525
   Track Skew        8    MSCP Cyl/Unit        1    CRC or ECC           1
   WR Precomp. TR 1225    MSCP Groups/Cyl      1    Max Bad Spots/Side  32
   RWC Track      1225    MSCP Tracks/Group    1    Bad Spot Tolerance 105
   Auto Recall TR 1225    Auto Recall TR 2  1226

XBN TR:0 SEC:02 Signature-OK CRC-OK
   Media ID     DURD54    XBN Size            54    GAP0                16
   Tracks         1225    DBN Size           201    GAP1                16
   Sides            15    LBN Size        311256    GAP2                 5
   Sectors          17    RBN Size           609    GAP3                40
   Interleave        1    RCT Size             7    SYNC                13
   Side Skew         2    RCT Number           8    Step Rate          525
   Track Skew        8    MSCP Cyl/Unit        1    CRC or ECC           1
   WR Precomp. TR 1225    MSCP Groups/Cyl      1    Max Bad Spots/Side  32
   RWC Track      1225    MSCP Tracks/Group    1    Bad Spot Tolerance 105
   Auto Recall TR 1225    Auto Recall TR 2  1226
Standard RD type: RD54
```

Example of successful SIMH DSK import sequence:

NOTE: Older versions of SIMH do not append file footers. If you have an older SIMH file - attach it once using the latest SIMH version in order for the proper footer to be installed.

```
Drive 2: Reading CFG ... /DEFAULT2.CFG found.

===================================CFG File====================================
[DSK]
Name=RD54 - Maxtor XT2190
Encoding=MFM
RPM=3600
Tracks=1225
Sides=15
Sectors=17
First Sector ID=0
Sector Size=512
Format=RQDX3
Interleave=1
===============================================================================

RD DSK Validation: CFG-RD54

XBN TR:0 SEC:00 Signature-ERROR
Fri  5 Mar 2021 11:13:43 ERROR: read_cfg: Invalid XBN
Not RQDX image, attempting import.
SIMH Footer Data
   Simulator:             MicroVAX II (KA630)
   Drive Type:            RD54
   Sector Size:           512
   Sector Count:          311200
   Transfer Element Size: 2
   Footer Version:        0
   Access Format:         1
   Creation Time:         Wed Feb 24 12:46:26 2021

Making backup copy: /DEFAULT2.DSK - 05 Mar 2021 11-13-43.bkp
Temp file /DEFAULT2.DSK.incomplete
Importing Data:
0000*
0001 0002 0003 0004 0005 ... 1209 1210 1211 1212 1213 1214 1215 1216 1217 1218
      1219 1220 +100 SEC 1221
+155 SEC 1221* 1222* 1223* 1224*
Renaming temp file...
RQDX Import Completed!
```

RQDX3 DSK may be exported back to SIMH format by accessing Drive Info Mode and pressing **Alt+C**



Creating OpenVMS image for Microvax II using Installation CD and SIMH

If you do not have installation media or appropriate media reading devices for your system, SIMH may be conveniently used for software installation.

```
MicroVAX II (KA630) simulator V4.0-0 Current        git commit id: 0912a927
sim> set rq0 rd54
sim> att rq0 RD54-OpenVMS-VAX-7.3-SIMH.dsk
RQ0: 'RD54-OpenVMS-VAX-7.3-SIMH.dsk' Contains ODS2 File system
RQ0: Volume Name: DREMVMS      Format: DECFILE11B   Sectors In Volume: 311200
sim>
sim> set rq1 ra92
sim> att rq1 OpenVMS-VAX-7.3.iso
RQ1: 'OpenVMS-VAX-7.3.iso' Contains ODS2 File system
RQ1: Volume Name: VAXVMS073    Format: DECFILE11B   Sectors In Volume: 1067894
sim> boot cpu
Loading boot code from internal ka630.bin



KA630-A.V1.3

Performing normal system tests.

  5..4..3..
```

```
Tests completed.


>>> boot dua1

  2..1..0..


%SYSBOOT-I-SYSBOOT Mapping the SYSDUMP.DMP on the System Disk
%SYSBOOT-W-SYSBOOT Can not map SYSDUMP.DMP on the System Disk
%SYSBOOT-W-SYSBOOT Can not map PAGEFILE.SYS on the System Disk
   OpenVMS (TM) VAX Version X7G7 Major version id = 1 Minor version id = 0
%WBM-I-WBMINFO Write Bitmap has successfully completed initialization.
PLEASE ENTER DATE AND TIME (DD-MMM-YYYY  HH:MM)  05-MAR-2021 12:23

Configuring devices . . .
Now configuring HSC, RF, and MSCP-served devices . . .

Please check the names of the devices which have been configured,
to make sure that ALL remote devices which you intend to use have
been configured.

If any device does not show up, please take action now to make it
available.


Available device  DUA0:                           device type RD54
Available device  DUA1:                           device type RA92
Available device  DUA2:                           device type RD54
Available device  DUA3:                           device type RX50
Available device  DLA0:                           device type RL01
Available device  DLA1:                           device type RL01
Available device  DLA2:                           device type RL01
Available device  DLA3:                           device type RL01
Available device  MSA0:                           device type MW_TSV05
Available device  MUA0:                           device type TK50
Available device  MUA1:                           device type TK50
Available device  MUA2:                           device type TK50
Available device  MUA3:                           device type TK50

Enter "YES" when all needed devices are available: yes
%BACKUP-I-IDENT, Stand-alone BACKUP T7.2; the date is  5-MAR-2021 12:25:24.68
$ backup dua1:vms073.b/save_set dua0:
%BACKUP-I-PROCDONE, operation completed.  Processing finished at  5-MAR-2021
      12:25:50.96
If you do not want to perform another standalone BACKUP operation,
use the console to halt the system.

If you do want to perform another standalone BACKUP operation,
```

```
ensure the standalone application volume is online and ready.
Enter "YES" to continue: yes
%BACKUP-I-IDENT, Stand-alone BACKUP T7.2; the date is  5-MAR-2021 12:26:05.32
$
```

<PRESS Ctrl+Break Here>

```
Simulation stopped, PC: 80A8198D (BBC #3,26C(R3),80A819E1)
sim> boot cpu


KA630-A.V1.3

Performing normal system tests.

  5..4..3..

Tests completed.


>>> boot dua0

  2..1..0..


%SYSBOOT-I-SYSBOOT Mapping the SYSDUMP.DMP on the System Disk
%SYSBOOT-W-SYSBOOT Can not map SYSDUMP.DMP on the System Disk
%SYSBOOT-I-SYSBOOT Mapping PAGEFILE.SYS on the System Disk
%SYSBOOT-I-SYSBOOT SAVEDUMP parameter not set to protect the PAGEFILE.SYS
   OpenVMS (TM) VAX Version BI73-7G7 Major version id = 1 Minor version id = 0
%WBM-I-WBMINFO Write Bitmap has successfully completed initialization.

           OpenVMS VAX V7.3 Installation Procedure

                      Model: MicroVAX II
                System device: RD54 - _DUA0:
                  Free Blocks: 224901
                     CPU type: 08-01



* Please enter the date and time (DD-MMM-YYYY HH:MM) 05-MAR-2021 12:29
************************************************************
%SYSTEM-W-TZGMT, your local timezone has defaulted to GMT
%SYSTEM-I-SETTZ, to set your local timezone use:

     $ @SYS$MANAGER:UTC$TIME_SETUP.COM

************************************************************
On MIN or UPGRADE system startup - CLUE is not run.
%%%%%%%%%%  OPCOM   5-MAR-2021 12:29:20.43  %%%%%%%%%%
```

```
Operator _OPA0: has been enabled, username SYSTEM

%%%%%%%%%%  OPCOM   5-MAR-2021 12:29:20.43  %%%%%%%%%%
Operator status for operator _OPA0:
CENTRAL, PRINTER, TAPES, DISKS, DEVICES, CARDS, NETWORK, CLUSTER, SECURITY,
LICENSE, OPER1, OPER2, OPER3, OPER4, OPER5, OPER6, OPER7, OPER8, OPER9, OPER10,
OPER11, OPER12

%%%%%%%%%%  OPCOM   5-MAR-2021 12:29:20.44  %%%%%%%%%%
Logfile has been initialized by operator _OPA0:
Logfile is SYS$SYSROOT:[SYSMGR]OPERATOR.LOG;1

%%%%%%%%%%  OPCOM   5-MAR-2021 12:29:20.44  %%%%%%%%%%
Operator status for operator SYS$SYSROOT:[SYSMGR]OPERATOR.LOG;1
CENTRAL, PRINTER, TAPES, DISKS, DEVICES, CARDS, NETWORK, CLUSTER, SECURITY,
LICENSE, OPER1, OPER2, OPER3, OPER4, OPER5, OPER6, OPER7, OPER8, OPER9, OPER10,
OPER11, OPER12

%SYSTEM-I-BOOTUPGRADE, security auditing disabled
%LICENSE-F-EMTLDB, license database contains no license records
%SYSTEM-I-BOOTUPGRADE, security server not started
%%%%%%%%%%  OPCOM   5-MAR-2021 12:29:21.07  %%%%%%%%%%
Message from user SYSTEM
%LICENSE-E-NOAUTH, DEC VAX-VMS use is not authorized on this node
-LICENSE-F-NOLICENSE, no license is active for this software product
-LICENSE-I-SYSMGR, please see your system manager


%LICENSE-E-NOAUTH, DEC VAX-VMS use is not authorized on this node
-LICENSE-F-NOLICENSE, no license is active for this software product
-LICENSE-I-SYSMGR, please see your system manager
Startup processing continuing...

%SET-I-INTSET, login interactive limit = 1, current interactive value = 0
%SET-I-INTSET, login interactive limit = 0, current interactive value = 0
%JBC-E-OPENERR, error opening SYS$COMMON:[SYSEXE]QMAN$MASTER.DAT;
-RMS-E-FNF, file not found

    If this system disk is to be used in an OpenVMS Cluster with multiple
    system disks, then each system disk must have a unique volume label.
    Any nodes having system disks with duplicate volume labels will fail
    to boot into the cluster.

    You can indicate a volume label of 1 to 12 characters in length.  If you
    want to use the default name of OVMSVAXSYS, press RETURN in response
    to the next question.

* Enter the volume label for this system disk [OVMSVAXSYS]: DREM

* Enter name of drive holding the OpenVMS distribution media: dua1
```

```
* Is the OpenVMS media ready to be mounted? [N] y
%MOUNT-I-MOUNTED, VAXVMS073 mounted on _DUA1:

    Select optional software you want to install.  You can install one
    or more of the following OpenVMS or DECwindows components:

    o OpenVMS library                                -  52200 blocks
    o OpenVMS optional                               -  19000 blocks
    o OpenVMS Help Message                           -  10400 blocks
    o OpenVMS Management Station                     -  20000 blocks
    o DECwindows base support                        -   4400 blocks
    o DECwindows workstation support                 -  23800 blocks
          -  75 dots per inch video fonts            -    (included)
          - 100 dots per inch video fonts            -   6200 blocks
    o DECnet-Plus networking                         -  80000 blocks
    o DECnet Phase IV networking                     -    800 blocks

    Space remaining on system disk:  224712 blocks

* Do you want to install the OpenVMS library files? (Y/N) y

    Space remaining on system disk:  172512 blocks

* Do you want to install the OpenVMS optional files? (Y/N) y

    Space remaining on system disk:  153512 blocks


    The Help Message utility (MSGHLP) provides online explanations
    and user actions for OpenVMS messages in place of the hardcopy
    OpenVMS System Messages and Recovery Procedures Reference Manual,
    which is now separately orderable.

    The MSGHLP database file, MSGHLP$LIBRARY.MSGHLP$DATA,
    consumes approximately 10400 blocks and will be
    placed by default on your system disk in SYS$COMMON:[SYSHLP]
    unless you specify an alternate device when prompted.

* Do you want to install the MSGHLP database? (Y/N) y

    You can install this database on your system disk in SYS$COMMON:[SYSHLP]
    or on an alternate device.  If you specify an alternate device, but no
    directory, MSGHLP$LIBRARY.MSGHLP$DATA is placed in [HELP_MESSAGE].  When
    prompted, take the default of the system disk or specify an alternate
    device using this format:

                          device:[directory]

* Where do you want to install the MSGHLP database?
    [SYS$COMMON:[SYSHLP]] <Press Enter>
```

```
    Space remaining on system disk:  143112 blocks


    The OpenVMS Management Station is a client-server application that
    provides OpenVMS system management capabilities through a client
    application on a personal computer (PC) running Microsoft Windows.

    The server application runs on OpenVMS systems and is automatically
    installed as part of the OpenVMS operating system.

    This option provides the files used to install the PC client software.
    If you want to use the OpenVMS Management Station, you must install
    these optional files on at least one OpenVMS system and then use one or
    both of them to install the PC client on one or more PCs.  There are two
    files:  TNT030_I.EXE for Intel systems (Windows 95 and Windows NT), and
    TNT030_A.EXE for Alpha Windows NT systems.

    The OpenVMS Management Station optional files consume approximately 20000
    blocks and will be placed on your system disk in SYS$COMMON:[TNT.CLIENT].

* Do you want to install the optional OpenVMS Management Station files? (Y/N) n

    You can select DECwindows now, or you can use the DECW$TAILOR utility
    to provide or remove DECwindows support after the installation.

    Some media, TK50s in particular, can be very slow when tailoring on files.
    You might want to select DECwindows now and tailor off unwanted files later.

    NOTE: This kit does NOT contain full DECwindows.
          To obtain full DECwindows, you must also install the separate
          layered product, DECwindows Motif for OpenVMS VAX.
          V1.2-3 is the minimum version of DECwindows Motif for OpenVMS VAX
          that can be used with OpenVMS VAX V7.3.

    The DECwindows components provided in this kit requires approximately
    34400 blocks, broken down as follows:

        o DECwindows base support                    -   4400 blocks
        o DECwindows workstation support             -  23800 blocks
          -  75 dots per inch video fonts            -    (included)
          - 100 dots per inch video fonts (optional) -   6200 blocks

    You must select the DECwindows base support option if
        - you plan to run DECwindows software, or
        - you are installing this kit on
            * a workstation or
            * an OpenVMS Cluster that contains workstations, or
        - you want to provide font files for Xterminals.

    If you are installing this kit on a system that includes Xterminals
```

```
    and you do NOT select DECwindows base support, then you will have to use
    the DECW$TAILOR utility to provide font files.

* Do you want the DECwindows base support? (Y/N) n

    Beginning with OpenVMS V7.1, the DECnet-Plus kit is provided with
    the OpenVMS operating system kit.  Compaq strongly recommends that
    DECnet users install DECnet-Plus.  DECnet Phase IV applications are
    supported by DECnet-Plus.

    DECnet Phase IV is also provided as an option.  Support for DECnet
    Phase IV is available through a Prior Version Support Contract.

    If you install DECnet-Plus and TCP/IP you can run DECnet
    applications over a TCP/IP network.  Please see the OpenVMS
    Management Guide for information on running DECnet over TCI/IP.

    If you plan to install DECnet Phase IV do NOT select DECnet-Plus.

* Do you want to install DECnet-Plus? (Y/N) y

    Space remaining on system disk:  63112 blocks

    DECnet Phase IV will not be installed.


    The following options will be provided:

        OpenVMS library
        OpenVMS optional
        OpenVMS Help Message
        DECnet-Plus

    Space remaining on system disk:  63112 blocks

* Is this correct? (Y/N) y

    Restoring OpenVMS library save set ...
%BACKUP-I-STARTVERIFY, starting verification pass

    Restoring OpenVMS optional save set ...
%BACKUP-I-STARTVERIFY, starting verification pass

    Restoring OpenVMS Help Message save set ...
%BACKUP-I-STARTVERIFY, starting verification pass

    Now registering the OpenVMS operating system in the
    POLYCENTER Software Installation product database
```

```
The following product will be registered:
    DEC VAXVMS VMS V7.3                    DISK$VAXVMSV73:[VMS$COMMON.]

The following product has been registered:
    DEC VAXVMS VMS V7.3                    Transition (registration)

    You can now remove the distribution kit from DUA1:.


    In an OpenVMS Cluster, you can run multiple systems sharing all files
    except PAGEFILE.SYS, SWAPFILE.SYS, SYSDUMP.DMP, and VAXVMSSYS.PAR.

    Cluster configuration cannot be done at this time because no network
    is present.  In order to configure a cluster you must FIRST do one
    or both of the following:

        o Install DECnet-Plus (or DECnet Phase IV), or
        o Execute SYS$STARTUP:LAN$STARTUP.COM by removing the
          comment delimiter ("!") from the line

                $! @SYS$STARTUP:LAN$STARTUP

          in SYS$MANAGER:SYSTARTUP_VMS.COM.

    Then configure the cluster by executing the following command:

                @ @SYS$MANAGER:CLUSTER_CONFIG

    See the OpenVMS System Manager's Manual: Essentials for more information.


    Now we will ask you for new passwords for the following accounts:

        SYSTEM, SYSTEST, FIELD

    Passwords must be a minimum of 8 characters in length.  All passwords
    will be checked and verified.  Any passwords that can be guessed easily
    will not be accepted.


* Enter password for SYSTEM: <Enter Password>
* Re-enter for verification: <Enter Password>
%UAF-I-MDFYMSG, user record(s) updated
%VMS-I-PWD_OKAY, account password for SYSTEM verified

* Enter password for SYSTEST: <Enter Password>
* Re-enter for verification: <Enter Password>
%UAF-I-MDFYMSG, user record(s) updated
%VMS-I-PWD_OKAY, account password for SYSTEST verified
```

```
    The SYSTEST_CLIG account will be disabled.  You must re-enable
    it before running UETP but do not assign a password.

%UAF-I-PWDLESSMIN, new password is shorter than minimum password length
%UAF-I-MDFYMSG, user record(s) updated

* Enter password for FIELD: <Enter Password>
* Re-enter for verification: <Enter Password>
%UAF-I-MDFYMSG, user record(s) updated
%VMS-I-PWD_OKAY, account password for FIELD verified


    Creating RIGHTS database file, SYS$SYSTEM:RIGHTSLIST.DAT
    Ignore any "-SYSTEM-F-DUPIDENT, duplicate identifier" errors.

%UAF-I-RDBCREMSG, rights database created
%UAF-I-RDBADDMSGU, identifier DEFAULT value [000200,000200] added to rights
      database
%UAF-I-RDBADDMSGU, identifier FIELD value [000001,000010] added to rights database
%UAF-I-RDBADDMSGU, identifier SYSTEM value [000001,000004] added to rights
      database
%UAF-I-RDBADDMSGU, identifier SYSTEST value [000001,000007] added to rights
      database
%UAF-E-RDBADDERRU, unable to add SYSTEST_CLIG value [000001,000007] to rights
      database
-SYSTEM-F-DUPIDENT, duplicate identifier
%UAF-I-NOMODS, no modifications made to system authorization file
%UAF-I-RDBDONEMSG, rights database modified

    Creating MODPARAMS.DAT database file, SYS$SYSTEM:MODPARAMS.DAT

* Please enter the SCSNODE name: DRMVAX

* Please enter the SCSSYSTEMID:  1025

    After the installation finishes, you might want to do one or more of the
    following tasks:

    o DECOMPRESS THE SYSTEM LIBRARIES - To save space, many of the system
      libraries are shipped in a data-compressed format.  If you have
      enough disk space, you can decompress the libraries for faster access.
      To data expand the libraries, type:

        $ @SYS$UPDATE:LIBDECOMP.COM

      If you do not decompress these libraries, you will experience
      slower response to the HELP and LINK commands.

    o BUILD A STANDALONE BACKUP KIT - You can build a standalone backup kit
```

```
      using the procedure described in the "Backup Procedures" chapter of
      tye upgrade and installation supplement provided for your VAX computer.

    o TAILOR THE SYSTEM DISK - You might want to review the files provided or
      not provided during this installation.  If you find there are files
      you want to remove from the system disk (TAILOR OFF) or files you want
      to add (TAILOR ON), use the following utilities to perform the
      desired tailoring.

          OpenVMS tailoring:          $ RUN SYS$UPDATE:VMSTAILOR

          DECwindows tailoring:       $ RUN SYS$UPDATE:DECW$TAILOR

      NOTE:  The tailor procedure cannot be used to TAILOR ON or TAILOR OFF
             files located on an alternate disk.


=================================================================
    Continuing with OpenVMS VAX V7.3 Installation Procedure.



    Configuring all devices on the system ...

    If you have Product Authorization Keys (PAKs) to register, you can
    register them now.

* Do you want to register any Product Authorization Keys? (Y/N): n

****************************************************************************

    After the system has rebooted you must register any Product
    Authorization Keys (PAKs) that you have received with this kit.
    You can register these PAKs by executing the following procedure:

        $ @SYS$UPDATE:VMSLICENSE

    See the OpenVMS License Management Utility Manual for any additional
    information you need.

****************************************************************************


%UTC-I-UPDTIME, updating Time Zone information in SYS$COMMON:[SYSEXE]


    Configuring the Local Time Zone


    TIME ZONE SPECIFICATION -- Main Time Zone Menu
```

```
      1) Australia       11) GMT            21) Mexico         31) Turkey
      2) Brazil          12) Greenwich      22) NZ             32) UCT
      3) CET             13) Hong Kong      23) NZ-CHAT        33) US
      4) Canada          14) Iceland        24) Navajo         34) UTC
      5) Chile           15) Iran           25) PRC            35) Universal
      6) Cuba            16) Israel         26) Poland         36) W-SU
      7) EET             17) Jamaica        27) ROC            37) WET
      8) Egypt           18) Japan          28) ROK            38) Zulu
      9) Factory         19) Libya          29) Singapore
     10) GB-Eire         20) MET            30) SystemV

      0) None of the above

Select the number above that best describes your location: 4

You selected Canada as your time zone.
Is this correct? (Yes/No) [YES]: yes

    Canada Time Zone Menu

       1) Atlantic     3) East-Saskatchewan   5) Mountain         7) Pacific
       2) Central      4) Eastern             6) Newfoundland     8) Yukon

       0) None of the above

Select the number above that best describes your location: 7

You selected Canada/Pacific as your time zone.
Is this correct? (Yes/No) [YES]: yes

    Default Time Differential Factor for standard time is -8:00.
    Default Time Differential Factor for daylight saving time is -7:00.


    The Time Differential Factor (TDF) is the difference between your
    system time and Coordinated Universal Time (UTC).  UTC is similar
    in most repects to Greenwich Mean Time (GMT).

    The TDF is expressed as hours and minutes, and should be entered
    in the hh:mm format.  TDFs for the Americas will be negative
    (-3:00, -4:00, etc.); TDFs for Europe, Africa, Asia and Australia
    will be positive (1:00, 2:00, etc.).

Is Daylight Savings time in effect? (Yes/No): no

Enter the Time Differential Factor [-8:00]: <Press Enter>

    NEW SYSTEM TIME DIFFERENTIAL FACTOR = -8:00.

Is this correct? [Y]: y
```

```
    DECnet-Plus will now be installed.

    Media containing the DECnet-Plus kit must be available.

    If you are installing OpenVMS from an Infoserver (DAD1)
    or local CD-ROM, there is a DECnet-Plus kit on the CD-ROM.

    If you are installing from a cartridge tape (TK50) or
    from an open reel tape, you should have a DECnet-Plus kit
    on cartidge tape or open reel tape.

    An appropriate DECnet-Plus kit may also be available on
    the Consolidated Distribution CD-ROM, or you may have a
    separate DECnet-Plus kit.

    NOTE: You may choose any available media for the
    DECnet-Plus kit.  It is NOT NECESSARY to use the same
    type of media that contained the OpenVMS kit.

    If you do not have a DECnet-Plus kit available, or if you
    have decided NOT to install/upgrade DECnet-Plus, you can
    bypass the DECnet-Plus installation by entering "EXIT"
    for the "name of drive holding the DECnet-Plus kit".

* Enter name of drive holding the DECnet-Plus kit: dua1
* Is DUA1: ready to be mounted? [N] y

The following product has been selected:
    DEC VAXVMS DECNET_OSI V7.3             Layered Product


Configuration phase starting ...

You will be asked to choose options, if any, for each selected product and for
any products that may be installed to satisfy software dependency requirements.

DEC VAXVMS DECNET_OSI V7.3: DECnet-Plus V7.3 for OpenVMS VAX

    Copyright 2001 Compaq Computer Corporation.

    Compaq Computer Corporation

    This product requires one of two PAKs: DVNETEND or DVNETRTG.

Do you want the defaults for all options? [YES] <Press Enter>
```

```
Do you want to review the options? [NO] <Press Enter>

Execution phase starting ...

The following product will be installed to destination:
    DEC VAXVMS DECNET_OSI V7.3             DISK$VAXVMSV73:[VMS$COMMON.]

Portion done: 0%...10%...20%...30%...40%...80%...90%...100%

The following product has been installed:
    DEC VAXVMS DECNET_OSI V7.3             Layered Product
******************************************************************************


    Running AUTOGEN to compute the new SYSTEM parameters ...

%AUTOGEN-I-BEGIN, GETDATA phase is beginning.
%AUTOGEN-I-NEWFILE, A new version of SYS$SYSTEM:PARAMS.DAT has been created.
        You may wish to purge this file.
%AUTOGEN-I-END, GETDATA phase has successfully completed.
%AUTOGEN-I-BEGIN, GENPARAMS phase is beginning.
%AUTOGEN-I-NEWFILE, A new version of SYS$MANAGER:VMSIMAGES.DAT has been created.
        You may wish to purge this file.
%AUTOGEN-I-NEWFILE, A new version of SYS$SYSTEM:SETPARAMS.DAT has been created.
        You may wish to purge this file.
%AUTOGEN-I-END, GENPARAMS phase has successfully completed.
%AUTOGEN-I-BEGIN, GENFILES phase is beginning.
%SYSGEN-I-EXTENDED, SYS$SYSROOT:[SYSEXE]PAGEFILE.SYS;1 extended
%SYSGEN-I-EXTENDED, SYS$SYSROOT:[SYSEXE]SWAPFILE.SYS;1 extended
%SYSGEN-I-CREATED, SYS$SPECIFIC:[SYSEXE]SYSDUMP.DMP;1 created
%SYSGEN-I-CREATED, DUA0:[SYS0.SYSEXE]ERRORLOG.DMP;1 created

%AUTOGEN-I-REPORT, AUTOGEN has produced some informational messages which
        have been stored in the file SYS$SYSTEM:AGEN$PARAMS.REPORT.  You may
        wish to review the information in that file.

%AUTOGEN-I-END, GENFILES phase has successfully completed.
%AUTOGEN-I-BEGIN, SETPARAMS phase is beginning.
%AUTOGEN-I-END, SETPARAMS phase has successfully completed.
%AUTOGEN-I-BEGIN, REBOOT phase is beginning.

    The system is shutting down to allow the system to boot with the
    generated site-specific parameters and installed images.

    The system will automatically reboot after the shutdown and the
    installation will be complete.



        SHUTDOWN -- Perform an Orderly System Shutdown
```

```
%SHUTDOWN-I-BOOTCHECK, performing reboot consistency check...
%SHUTDOWN-I-CHECKOK, basic reboot consistency check completed

%SHUTDOWN-I-OPERATOR, this terminal is now an operator's console
%OPCOM-W-NOOPCOM, the request was not sent, the OPCOM process is not running
%SHUTDOWN-I-DISLOGINS, interactive logins will now be disabled
%SET-I-INTSET, login interactive limit = 0, current interactive value = 0
%SHUTDOWN-I-STOPQUEUES, the queues on this node will now be stopped
%JBC-E-OPENERR, error opening SYS$COMMON:[SYSEXE]QMAN$MASTER.DAT;
-RMS-E-FNF, file not found

SHUTDOWN message from user SYSTEM at  Batch   12:36:42
The system will shut down in 0 minutes; back up SOON.  Please log off.
Reboot system with AUTOGENerated parameters


%SHUTDOWN-I-STOPUSER, all user processes will now be stopped
%SHUTDOWN-I-REMOVE, all installed images will now be removed
%SHUTDOWN-I-DISMOUNT, all volumes will now be dismounted
%OPCOM-W-NOOPCOM, the request was not sent, the OPCOM process is not running
%OPCOM-W-NOOPCOM, the request was not sent, the OPCOM process is not running
HALT instruction, PC: 81211831 (MOVL @#8000412B,R1)
sim>
```

At this point file **RD54-OpenVMS-VAX-7.3-SIMH.dsk** contains an OpenVMS disk image ready to be transferred to DREM.

Other OS'es for Microvax II using SIMH

NetBSD and ULTRIX images may be prepared using SIMH.

```
set rq0 rd54
att rq0 RD54-netbsd-7.2-SIMH.dsk

set rq1 ra92
att rq1 NetBSD-7.2-vax.iso
boot cpu
```

```
set rq0 rd54
att rq0 rd54-Ultrix_VAX_4.5-SIMH.dsk

set rq2 ra92
att rq2 ultrix-vax-4.5-mode1.ufs
boot cpu
```

How to connect cables

DEC M7555 RQDX3 adapter is somewhat different from other MFM controllers: it requires the use of a DEC BA23 (or any BA23 variant) chassis with 70199806-00 Signal Distribution Panel or a DEC M9058-A1 Expander board to connect drives.

DEC BA23

BA23	DREM
J7 Fixed Disk 0	HDD_CONN P103
J2 Fixed Disk 0	HDD0_DAT P104
J6 Removable Disks 1+2	FLOPPY P101
J5 Fixed Disk 1	HDD1_DAT P105
J1 Fixed Disk	Do Not Connect

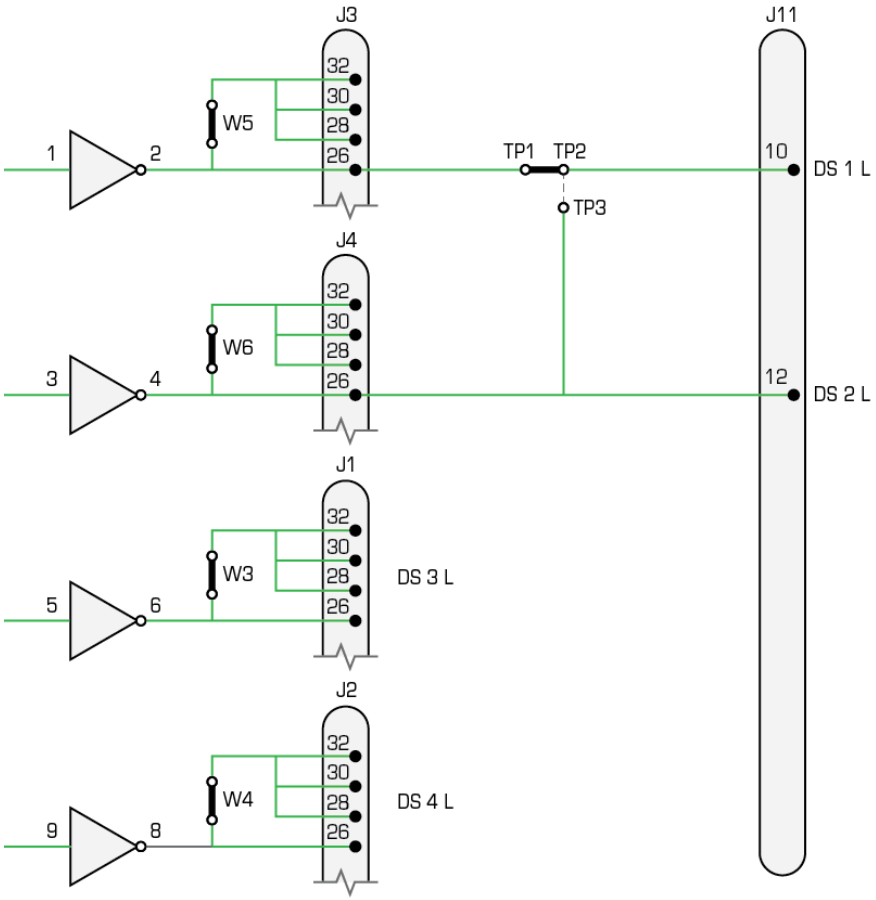
DREM2.INI Settings:

```
[hard drive 0]
enabled                         = NO
dsk file                        = /DEFAULT0.DSK
data connector                  = 2


[hard drive 1]
enabled                         = NO
dsk file                        = /DEFAULT1.DSK
data connector                  = 3


[hard drive 2]
enabled                         = YES
dsk file                        = /DEFAULT2.DSK
data connector                  = 0


[hard drive 3]
enabled                         = YES
dsk file                        = /DEFAULT3.DSK
data connector                  = 1


[floppy drive a]
enabled                         = YES
```

```
dsk file                        = /DEFAULTA.DSK


[floppy drive b]
enabled                         = YES
dsk file                        = /DEFAULTB.DSK


[floppy drive c]
enabled                         = NO
dsk file                        = /DEFAULTC.DSK


[floppy drive d]
enabled                         = NO
dsk file                        = /DEFAULTD.DSK
```

DEC M9058-A1 Expander

DEC M9058-A1 Expander RD/RX Board is using separate connectors for MFM control interface cable for each drive. By default all drive select signals on each connector are tied together.



In order to connect a single drive to DREM jumpers W3, W4, W5 and W6 must be removed, this will leave signal /DS0 active while decoupling other drive select signals. On some M9058 boards these jumpers are soldered in permanently. In this case DREM provides a simple solution: enable only Hard Drive 1 in **DREM2.INI** file and DREM will disregard all drive select signals but /DS0.

In order to use DREM HDD2 header with RQDX3:

- Connect DREM to J3
- Remove jumper W5
- Connect W6 to W5 pin leading to J3 pins 28,30,32
- Enable Hard Drive 0 and Hard Drive 1 in **DREM2.INI** file

NOTE: If you are using DEC M7513 Expander RD/RX Board (RQDXE) and BA23 or BA23-C distributor panels, please refer to DEC manuals to make correct connections.

NOTE: Please see **Appendix 3** for instructions on connecting four HDD's to DREM ST506/ST412 interface.

***TIP*:** The RQDX3 assigned LUNs to the physical drives based upon the drive select lines connected and numbers of drives in the system. The controller looks for disk drives in the following order:

1. DS3
2. DS4
3. DS1
4. DS2

Because of this action there will be no gaps in LUN numbering of drives connected to the controller. Please use an appropriate TP jumper setting and connect DREM to one of J1, J2, J3 or J4 in order to have desired LUN distribution between FDD and HDD.

HDD formatting with *XXDP V2.5*

In this example **DU1:** is RX33 with *XXDP V2.5* floppy and **DU0:** is RD51 with blank image.

NOTE: XXDP is not using interrupts and it is very slow by design. It is normal.

NOTE: For your convenience DREM is supplied with a set of pre-formatted images for all drive types.

NOTE: Important settings are:

Do you want to use the "AUTOFORMAT" Mode = NO

Do you want to use manufacturing bad block information = NO

Continue if bad block information is inaccessible = YES

```
                        BOOTING FROM DU1

BOOTING UP XXDP-XM EXTENDED MONITOR


XXDP-XM EXTENDED MONITOR - XXDP V2.5
REVISION: F0
BOOTED FROM DU1
124KW OF MEMORY
```



```
NON-UNIBUS SYSTEM

RESTART ADDRESS: 152000
TYPE "H" FOR HELP !

.RUN ZRQCH0
ZRQCH0.BIN

DRSSM-G2
ZRQC-H-0
RQDX3 Disk Formatter Utility
UNIT IS Formattable Winchester (RDnn) or Floppy (RX33) Drives
RSTRT ADR 145702
DR>START

CHANGE HW (L)  ? Y

# UNITS (D)  ? 1

UNIT 0
Enter controller IP Address (O)  172150 ? <Press Enter>
What unit do you want to format [0-255] (D)  0 ? <Press Enter>
Would you like to revector a single LBN only [Y/N] (L) ? N
Do you want to use the "AUTOFORMAT" Mode [Y/N] (L) Y ? N


Would you like to use the RCT - Revector known bad blocks [Y/N] (L) ? N


                        **** WARNING ****

         ALL DATA ON SELECTED DRIVE WILL BE DESTROYED

         Write protect all drives not being formatted.
         Please verify that the selected drive is ON LINE
         and NOT write protected.

         If formatting RX33 media, insert media to be
         formatted in the selected drive.

Do you wish to continue [Y/N] (L) Y ? Y


MSCP Controller Model:  19
    Microcode Version:   3

Do you want to use manufacturing bad block information [Y/N] (A) N ? N

Downline load UIT [Y/N] (A) Y ? Y
```

```
 UIT  Drive Name
------------------------------------------------------
  0   RD51
  1   RD52 part # 30-21721-02 (1 light on front panel)
  2   RD52 part # 30-23227-02 (2 lights on front panel)
  3   RD53
  4   RD31
  5   RD54
  6   RD32
  7   RD33

Enter Unit Identifier Table (UIT) [0-7] (D)  ? 0

Continue if bad block information is inaccessible [Y/N] (A) N ? Y

Please type in the serial number [8-10 digits] (A)  ? 12345678


Formatting of Drive 0 Begun.


       ------------ FORMAT PROGRESS REPORT -------------


  1 minute into format  ----   Formatting tracks, LBN # 9703
  2 minutes into format ----   Formatting tracks, LBN # 19225
  3 minutes into format ----   First check pass, writing LBN # 16614
  4 minutes into format ----   First check pass, reading LBN # 14598
  6 minutes into format ----   Second check pass, writing LBN # 16686
  7 minutes into format ----   Second check pass, reading LBN # 14670
  8 minutes into format ----   Third check pass, writing LBN # 16686
  9 minutes into format ----   Third check pass, reading LBN # 14670


Format Completed.

00000 Rev LBNs
00000 Bad RBNs
00000 Bad DBNs
00000 Bad XBNs
00000 retired

FCT was not used.

Drive 0 has been formatted successfully.

ZRQC EOP    1
    0 TOTAL ERRS
```

```
DR>
```

XXDP V2.5 Installation

Now the RD51 image is ready for an OS installation. Previous example session is continued here with *XXDP V2.5* transfer from **DU1:** to **DU0:**

NOTE: XXDP is not using interrupts and it is very slow by design. It is normal.

NOTE: Earlier *XXDP+* versions transfer procedure is different.

NOTE: If you want to install *RT11* please proceed to the next example.

```
DR>EXIT

.INIT DU0:
USER DATA ON DU0 WILL BE DESTROYED !
PROCEED?(Y/N/CR=N)Y

.RUN UPDAT
UPDAT .BIC

UPDAT - XXDP V2 UPDATE UTILITY REVISION G
RESTART: 004140

*CREATE DU0:

*EXIT

.COPY *.* DU0:
ZRQAH0.BIN
ZRQBC1.BIN
ZRQCH0.BIN
ZRQDA0.BIN
ZRQGC0.BIN
DATE  .SYS
DIR   .SYS
HELP  .TXT
DUSZ  .SYS
DU    .SYS
UPDAT .BIC
XXDPSM.SYS
XXDPXM.SYS
DRSSM .SYS

.DIR DU0:
```

```
ENTRY# FILNAM.EXT        DATE          LENGTH  START   VERSION

    1  ZRQAH0.BIN       1-MAR-89         67    000522
    2  ZRQBC1.BIN       1-MAR-89         20    000625
    3  ZRQCH0.BIN       1-MAR-89         72    000651
    4  ZRQDA0.BIN       1-MAR-89         71    000761
    5  ZRQGC0.BIN       1-MAR-89         74    001070
    6  DATE  .SYS       1-MAR-89          2    001202   B.0
    7  DIR   .SYS       1-MAR-89          7    001204   D.0
    8  HELP  .TXT       1-MAR-89         29    001213
    9  DUSZ  .SYS       1-MAR-89          2    001250   C.0
   10  DU    .SYS       1-MAR-89          4    001252   E.0
   11  UPDAT .BIC       1-MAR-89         29    001256
   12  XXDPSM.SYS       1-MAR-89         29    001313   E.0
   13  XXDPXM.SYS       1-MAR-89         39    001350   F.0
   14  DRSSM .SYS       1-MAR-89         24    001417   G.2

FREE BLOCKS: 20793


.
```

Now you may boot XXDP from the HDD.

.**BOOT DU0:**

```
BOOTING UP XXDP-XM EXTENDED MONITOR


XXDP-XM EXTENDED MONITOR - XXDP V2.5
REVISION: F0
BOOTED FROM DU0
124KW OF MEMORY
NON-UNIBUS SYSTEM

RESTART ADDRESS: 152000
TYPE "H" FOR HELP !
```

RT11 installation

In this example **DU1:** is RX33 with *RT11* floppy and **DU0:** is RD51 with *XXDP* formatted image.

```
                        BOOTING FROM DU1
RT-11XM  V05.06

.TYPE V5USER.TXT

                           RT-11 V5.6

    Installation  of  RT-11  Version  5.6 is complete and you are now running
    RT-11 from your system volume.

    Your  system volume is your working volume if you have used the Automatic
    Installation (AI) procedure.  If you  have  installed  RT-11  using  that
    procedure,  Digital  recommends  you verify the correct operation of your
    system's software using the VERIFY verification procedure.  You can  only
    perform  VERIFY  on  the  valid target (output) media you used for the AI
    procedure.  Run VERIFY before you run CONFIG.  To run VERIFY,  enter  the
    command:
                                  IND VERIFY

    Digital  recommends  you  read the file V5NOTE.TXT, which you can TYPE or
    PRINT.  Also, read the Introduction to RT-11, rewritten for  V5.6,  which
    contains much of the information you need to use RT-11 Version 5.6.


.R MSCPCK

.INIT DU0:
DU0:/Initialize; Are you sure? Y

.COPY /SYSTEM DU1: DU0:
 Files copied:
DU1:SWAP.SYS   to DU0:SWAP.SYS
DU1:RT11SB.SYS to DU0:RT11SB.SYS
DU1:TT.SYS     to DU0:TT.SYS
DU1:DU.SYS     to DU0:DU.SYS
DU1:PIP.SAV    to DU0:PIP.SAV
DU1:DUP.SAV    to DU0:DUP.SAV
DU1:DIR.SAV    to DU0:DIR.SAV
DU1:IND.SAV    to DU0:IND.SAV
DU1:FORMAT.SAV to DU0:FORMAT.SAV
DU1:TERMID.SAV to DU0:TERMID.SAV
DU1:CONFIG.SAV to DU0:CONFIG.SAV
DU1:RESORC.SAV to DU0:RESORC.SAV
DU1:EDIT.SAV   to DU0:EDIT.SAV
DU1:KED.SAV    to DU0:KED.SAV
```

```
DU1:KEX.SAV    to DU0:KEX.SAV
DU1:MACRO.SAV  to DU0:MACRO.SAV
DU1:CREF.SAV   to DU0:CREF.SAV
DU1:LINK.SAV   to DU0:LINK.SAV
DU1:MONMRG.SAV to DU0:MONMRG.SAV
DU1:LIBR.SAV   to DU0:LIBR.SAV
DU1:FILEX.SAV  to DU0:FILEX.SAV
DU1:SRCCOM.SAV to DU0:SRCCOM.SAV
DU1:BINCOM.SAV to DU0:BINCOM.SAV
DU1:SLP.SAV    to DU0:SLP.SAV
DU1:DUMP.SAV   to DU0:DUMP.SAV
DU1:SIPP.SAV   to DU0:SIPP.SAV
DU1:BUP.SAV    to DU0:BUP.SAV
DU1:PAT.SAV    to DU0:PAT.SAV
DU1:HELP.SAV   to DU0:HELP.SAV
DU1:BATCH.SAV  to DU0:BATCH.SAV
DU1:QUEMAN.SAV to DU0:QUEMAN.SAV
DU1:SETUP.SAV  to DU0:SETUP.SAV
DU1:VTCOM.SAV  to DU0:VTCOM.SAV
DU1:DATIME.SAV to DU0:DATIME.SAV
DU1:LET.SAV    to DU0:LET.SAV
DU1:SPLIT.SAV  to DU0:SPLIT.SAV
DU1:UCL.SAV    to DU0:UCL.SAV
DU1:VBGEXE.SAV to DU0:VBGEXE.SAV
DU1:SPOOL.SAV  to DU0:SPOOL.SAV
DU1:TRANSF.SAV to DU0:TRANSF.SAV
DU1:MDUP.SAV   to DU0:MDUP.SAV
DU1:ERROUT.SAV to DU0:ERROUT.SAV
DU1:MSCPCK.SAV to DU0:MSCPCK.SAV
DU1:GIDIS.SAV  to DU0:GIDIS.SAV
DU1:DBGSYM.SAV to DU0:DBGSYM.SAV
DU1:INDEX.SAV  to DU0:INDEX.SAV
DU1:INDEXX.SAV to DU0:INDEXX.SAV
DU1:STRTSB.COM to DU0:STRTSB.COM
DU1:RT11XM.SYS to DU0:RT11XM.SYS
DU1:DUX.SYS    to DU0:DUX.SYS
DU1:STRTXM.COM to DU0:STRTXM.COM
DU1:DD.SYS     to DU0:DD.SYS
DU1:DDX.SYS    to DU0:DDX.SYS
DU1:V5USER.TXT to DU0:V5USER.TXT
DU1:V5NOTE.TXT to DU0:V5NOTE.TXT
```

. **COPY /BOOT:DU DU0:RT11XM.SYS DU0:**

.

Now you may boot *RT11* from the HDD.

. **BOOT DU0:**


```
RT-11XM  V05.06

.TYPE V5USER.TXT

                              RT-11 V5.6

    Installation  of  RT-11  Version  5.6 is complete and you are now running
    RT-11 from your system volume.

    Your  system volume is your working volume if you have used the Automatic
    Installation (AI) procedure.  If you  have  installed  RT-11  using  that
    procedure,  Digital  recommends  you verify the correct operation of your
    system's software using the VERIFY verification procedure.  You can  only
    perform  VERIFY  on  the  valid target (output) media you used for the AI
    procedure.  Run VERIFY before you run CONFIG.  To run VERIFY,  enter  the
    command:
                                   IND VERIFY

    Digital  recommends  you  read the file V5NOTE.TXT, which you can TYPE or
    PRINT.  Also, read the Introduction to RT-11, rewritten for  V5.6,  which
    contains much of the information you need to use RT-11 Version 5.6.


.R MSCPCK

.DIR

SWAP  .SYS    28  09-May-96      RT11SB.SYS    97  09-May-96
TT    .SYS     2  09-May-96      DU    .SYS    10  09-May-96
PIP   .SAV    30  09-May-96      DUP   .SAV    52  09-May-96
DIR   .SAV    20  09-May-96      IND   .SAV    58  09-May-96
FORMAT.SAV    27  09-May-96      TERMID.SAV     4  09-May-96
CONFIG.SAV    10  09-May-96      RESORC.SAV    35  09-May-96
EDIT  .SAV    19  09-May-96      KED   .SAV    85  09-May-96
KEX   .SAV    72  09-May-96      MACRO .SAV    63  09-May-96
CREF  .SAV     6  09-May-96      LINK  .SAV    58  09-May-96
MONMRG.SAV    14  09-May-96      LIBR  .SAV    24  09-May-96
FILEX .SAV    22  09-May-96      SRCCOM.SAV    26  09-May-96
BINCOM.SAV    25  09-May-96      SLP   .SAV    13  09-May-96
DUMP  .SAV    10  09-May-96      SIPP  .SAV    21  09-May-96
BUP   .SAV    68  09-May-96      PAT   .SAV    11  09-May-96
HELP  .SAV   160  09-May-96      BATCH .SAV    26  09-May-96
QUEMAN.SAV    15  09-May-96      SETUP .SAV    43  09-May-96
VTCOM .SAV    24  09-May-96      DATIME.SAV     4  09-May-96
LET   .SAV     6  09-May-96      SPLIT .SAV     3  09-May-96
UCL   .SAV    16  09-May-96      VBGEXE.SAV    18  09-May-96
SPOOL .SAV    22  09-May-96      TRANSF.SAV    16  09-May-96
MDUP  .SAV    21  09-May-96      ERROUT.SAV    37  09-May-96
MSCPCK.SAV     4  09-May-96      GIDIS .SAV    72  09-May-96
DBGSYM.SAV    10  09-May-96      INDEX .SAV    11  09-May-96
INDEXX.SAV    14  09-May-96      STRTSB.COM     1  09-May-96
```

```
RT11XM.SYS   124  09-May-96      DUX    .SYS    13  09-May-96
STRTXM.COM     8  09-May-96      DD     .SYS     5P 20-Dec-85
DDX    .SYS     5P 20-Dec-85     V5USER.TXT      2  09-May-96
V5NOTE.TXT    49  09-May-96
 55 Files, 1639 Blocks
 19893 Free blocks
```

FDD formatting

There is no need to format RX50 and RX33 disks. RX50 media was supplied preformatted at the factory and there is no way to perform LLF on PDP.

If you wish to format RX33 it may be done with *XXDP V2.5* and *ZRQCH0* utility.

NOTE: Important settings are:

Do you want to use the "AUTOFORMAT" Mode = NO

Would you like to test the diskette - is optional and may be set to NO

```
                    BOOTING FROM DU1

BOOTING UP XXDP-XM EXTENDED MONITOR


XXDP-XM EXTENDED MONITOR - XXDP V2.5
REVISION: F0
BOOTED FROM DU1
124KW OF MEMORY
NON-UNIBUS SYSTEM

RESTART ADDRESS: 152000
TYPE "H" FOR HELP !

.RUN ZRQCH0
ZRQCH0.BIN

DRSSM-G2
ZRQC-H-0
RQDX3 Disk Formatter Utility
UNIT IS Formattable Winchester (RDnn) or Floppy (RX33) Drives
RSTRT ADR 145702
DR>START

CHANGE HW (L)  ? Y

# UNITS (D)  ? 1

UNIT 0
```



```
Enter controller IP Address (O)  172150 ? <Press Enter>
What unit do you want to format [0-255] (D)  0 ? 1
Would you like to revector a single LBN only [Y/N] (L) ? N
Do you want to use the "AUTOFORMAT" Mode [Y/N] (L) Y ? N

Would you like to use the RCT - Revector known bad blocks [Y/N] (L) ? N

                        **** WARNING ****

         ALL DATA ON SELECTED DRIVE WILL BE DESTROYED

         Write protect all drives not being formatted.
         Please verify that the selected drive is ON LINE
         and NOT write protected.

         If formatting RX33 media, insert media to be
         formatted in the selected drive.

Do you wish to continue [Y/N] (L) Y ? Y


MSCP Controller Model:  19
    Microcode Version:   3

Formatting of Diskette on Drive 1 Begun.

Drive 1 has been formatted successfully.


Would you like to test the diskette [Y/N] (L) Y ? <Press Enter>

Testing LBN's on diskette ...

All available LBN's have been tested for errors.
Total bad track(s) found:    0

Would you like to format another diskette [Y/N] (L) Y ? N

ZRQC EOP    1
    0 TOTAL ERRS

DR>
```

DEC RL

Up to 4 RL drives may be used.

NOTE: DSK image size is exactly 5Mb for RL01 and 10Mb for RL02. Important is to have new **DSK** files to be padded with 0xFF byte. Zero padded **DSK** file will cause RT-11 INIT failures:

.**INIT DL0:**

```
DL0:/Initialize; Are you sure? Y
?DUP-F-Bad block in system area DL0:
```

.**INIT /BADBLOCKS DL0:**

```
DL0:/Initialize; Are you sure? Y
    Block          Type
?DUP-W-Bad blocks detected 220.
?DUP-F-Bad block in system area DL0:
```

You may use default **DSK** files supplied with DREM or create your own using UNIX:

```
dd if=/dev/zero bs=1M count=5  | tr '\000' '\377' > rl01.dsk


dd if=/dev/zero bs=1M count=10 | tr '\000' '\377' > rl02.dsk
```

Initializing an RL **DSK** image is a very simple process. You don't need to use *XXDP* to do so. Instead, just start by issuing INIT command under *RT-11* and continue as described in **RQDX3** section:

```
.INIT DL0:

.COPY /SYSTEM DU0: DL0:

.COPY /BOOT:DL DU0:RT11XM.SYS DL0:

.BOOT DL0:
```

Dilog DQ614

- ALTERNATE CYLINDERS - are not supported, set to 0
- Always add one extra track to the emulated physical drive.

An example for Seagate ST124:

[DSK]
Name=Seagate ST124 21M
Encoding=MFM
RPM=3600
Tracks=616 ; +1 extra track for metadata, use 615 tracks in DQ615P.SAV
Sides=4
Sectors=17
First Sector ID=0
Sector Size=512
Format=DILOG-DQ614
Interleave=4
Side Skew=12

```
                          BOOTING FROM DU0
RT-11XM  V05.06

.TYPE V5USER.TXT

                                    RT-11 V5.6

    Installation  of  RT-11  Version  5.6 is complete and you are now running
    RT-11 from your system volume.

    Your  system volume is your working volume if you have used the Automatic
    Installation (AI) procedure.  If you  have  installed  RT-11  using  that
    procedure,  Digital  recommends  you verify the correct operation of your
    system's software using the VERIFY verification procedure.  You can  only
    perform  VERIFY  on  the  valid target (output) media you used for the AI
    procedure.  Run VERIFY before you run CONFIG.  To run VERIFY,  enter  the
    command:
                                    IND VERIFY

    Digital  recommends  you  read the file V5NOTE.TXT, which you can TYPE or
    PRINT.  Also, read the Introduction to RT-11, rewritten for  V5.6,  which
    contains much of the information you need to use RT-11 Version 5.6.


.R MSCPCK
```

```
.DQ614P

  DQ614 REV-O  DIAGNOSTIC



ARE YOU RUNNING THE DIAGNOSTIC VIA A C.R.T. (Y OR N)Y
 ENTER RL DEVICE ADDRESS  <174400> ?
 ENTER RL INTERRUPT VECTOR   <160> ?
ENTER NUMBER OF DRIVES ON SUBSYSTEM (1 OR 2) ?  1


  PAGE  1

   1 = CMI 5410                  2 = CMI 5616

   3 = CMI 5619                  4 = CMI 5412

   5 = CMI 5640                  6 = IMI 5006

   7 = IMI 5006H                 8 = IMI 5012H

   9 = IMI 5018H                10 = OLIVETTI HD 562/12

----------------------------------------------------------------

            ****************DRIVE 0******************

            ENTER NUMBER CORRESPONDING TO DISC DRIVE
                              OR
                      SELECT ANOTHER PAGE

    N = NEXT PAGE   P = PREVIOUS PAGE    E = DRIVE NOT FOUND

      ENTER >  E
 ENTER NUMBER OF HEADS (D)  ?  4
 ENTER NUMBER OF CYLINDERS (D)  ?  615
 REDUCE WRITE CURRENT AT CYLINDER (NOT USED)  ?
 START PRECOMPENSATION AT CYLINDER (NOT USED)  ?
ENTER NUMBER CORRESPONDING TO THE PROPER STEP RATE
     1 = 26 US
     2 = 280 US
     3 = 2.1 MS
     4 = 3.0 MS
  ENTER >  1

       DISC CONFIGURATION  ***DRIVE 0***

ENTER NUMBER CORRESPONDING TO THE TYPE OF RL UNIT
     1 = RL01 (10240 BLOCKS; 151 CYLS)
     2 = RL02 (20480 BLOCKS; 302 CYLS)
```



```
(XXX) = CYLINDERS NOT YET ALLOCATED

YOU HAVE 615 CYLINDERS
USE THE <TAB> TO ENTER TYPE OF RL UNIT
CARRIAGE RETURN COMPLETES CONFIGURATION PROCEDURE


    DL0:2   (313)   DL1:2   (   )   DL2:    (   )   DL3:
 ENTER NUMBER OF ALTERNATE CYLINDERS (D)  ?  0


                  DISC SUBSYSTEM CONFIGURATION

   LOGICAL       PHYSICAL        MEGABYTES          RECORD
    UNIT           DRIVE                            SIZE


     DL0             0             10.48             20480
     DL1             0             10.89             21284


                ------------------------------

    PHYSICAL DRIVE 0 HAS   0  ALTERNATE TRACKS
    SET SWITCH 3 OFF
    SET SWITCH 4 ON

 ARE YOU SURE  ? Y
TESTING CONTROLLER REGISTERS

TESTING DATA BUFFER

FORMAT DL0 (Y OR N) ? Y
 ARE YOU SURE  ? Y
WRITING HEADERS

CURRENT CYLINDER ADDRESS   302
READING HEADERS

CURRENT CYLINDER ADDRESS   302
WRITING DATA TEST PATTERN

CURRENT CYLINDER ADDRESS   301
READING DATA TEST PATTERN

CURRENT CYLINDER ADDRESS   301
DL0 FORMAT AND VERIFICATION COMPLETE

FORMAT DL1 (Y OR N) ? Y
 ARE YOU SURE  ? Y
WRITING HEADERS
```

```
CURRENT CYLINDER ADDRESS   615
READING HEADERS

CURRENT CYLINDER ADDRESS   615
WRITING DATA TEST PATTERN

CURRENT CYLINDER ADDRESS   603
READING DATA TEST PATTERN

CURRENT CYLINDER ADDRESS   603
DL1 FORMAT AND VERIFICATION COMPLETE

SEQUENTIAL READ (ALL CYL AND HEADS) ?N
READ DL0 (Y OR N) ? N
READ DL1 (Y OR N) ? N
RANDOM SEEK,READ OF DRIVE (ALL CYL AND HEADS) ? N
RANDOM SEEK,WRITE DATA,READ DATA,COMPARE TEST ? N
TEST ECC ? N
USE  (R) TO REPEAT TEST
USE (O) TO TRANSFER TO ODT
USE (L) TO REBOOT YOUR SYSTEM
================================================================================
                         BOOTING FROM DU0
RT-11XM  V05.06

.TYPE V5USER.TXT

                                  RT-11 V5.6

    Installation  of  RT-11  Version  5.6 is complete and you are now running
    RT-11 from your system volume.

    Your  system volume is your working volume if you have used the Automatic
    Installation (AI) procedure.  If you  have  installed  RT-11  using  that
    procedure,  Digital  recommends  you verify the correct operation of your
    system's software using the VERIFY verification procedure.  You can  only
    perform  VERIFY  on  the  valid target (output) media you used for the AI
    procedure.  Run VERIFY before you run CONFIG.  To run VERIFY,  enter  the
    command:
                                  IND VERIFY

    Digital  recommends  you  read the file V5NOTE.TXT, which you can TYPE or
    PRINT.  Also, read the Introduction to RT-11, rewritten for  V5.6,  which
    contains much of the information you need to use RT-11 Version 5.6.


.R MSCPCK

.INI DL0:
DL0:/Initialize; Are you sure? Y
```

```
.COPY /SYS DU0: DL0:
 Files copied:
DU0:SWAP.SYS   to DL0:SWAP.SYS
DU0:RT11SB.SYS to DL0:RT11SB.SYS
DU0:TT.SYS     to DL0:TT.SYS
DU0:DU.SYS     to DL0:DU.SYS
DU0:PIP.SAV    to DL0:PIP.SAV
DU0:DUP.SAV    to DL0:DUP.SAV
DU0:DIR.SAV    to DL0:DIR.SAV
DU0:IND.SAV    to DL0:IND.SAV
DU0:FORMAT.SAV to DL0:FORMAT.SAV
DU0:TERMID.SAV to DL0:TERMID.SAV
DU0:CONFIG.SAV to DL0:CONFIG.SAV
DU0:RESORC.SAV to DL0:RESORC.SAV
DU0:EDIT.SAV   to DL0:EDIT.SAV
DU0:KED.SAV    to DL0:KED.SAV
DU0:KEX.SAV    to DL0:KEX.SAV
DU0:MACRO.SAV  to DL0:MACRO.SAV
DU0:CREF.SAV   to DL0:CREF.SAV
DU0:LINK.SAV   to DL0:LINK.SAV
DU0:MONMRG.SAV to DL0:MONMRG.SAV
DU0:LIBR.SAV   to DL0:LIBR.SAV
DU0:FILEX.SAV  to DL0:FILEX.SAV
DU0:SRCCOM.SAV to DL0:SRCCOM.SAV
DU0:BINCOM.SAV to DL0:BINCOM.SAV
DU0:SLP.SAV    to DL0:SLP.SAV
DU0:DUMP.SAV   to DL0:DUMP.SAV
DU0:SIPP.SAV   to DL0:SIPP.SAV
DU0:BUP.SAV    to DL0:BUP.SAV
DU0:PAT.SAV    to DL0:PAT.SAV
DU0:HELP.SAV   to DL0:HELP.SAV
DU0:BATCH.SAV  to DL0:BATCH.SAV
DU0:QUEMAN.SAV to DL0:QUEMAN.SAV
DU0:SETUP.SAV  to DL0:SETUP.SAV
DU0:VTCOM.SAV  to DL0:VTCOM.SAV
DU0:DATIME.SAV to DL0:DATIME.SAV
DU0:LET.SAV    to DL0:LET.SAV
DU0:SPLIT.SAV  to DL0:SPLIT.SAV
DU0:UCL.SAV    to DL0:UCL.SAV
DU0:VBGEXE.SAV to DL0:VBGEXE.SAV
DU0:SPOOL.SAV  to DL0:SPOOL.SAV
DU0:TRANSF.SAV to DL0:TRANSF.SAV
DU0:MDUP.SAV   to DL0:MDUP.SAV
DU0:ERROUT.SAV to DL0:ERROUT.SAV
DU0:MSCPCK.SAV to DL0:MSCPCK.SAV
DU0:GIDIS.SAV  to DL0:GIDIS.SAV
DU0:DBGSYM.SAV to DL0:DBGSYM.SAV
DU0:INDEX.SAV  to DL0:INDEX.SAV
DU0:INDEXX.SAV to DL0:INDEXX.SAV
```

```
DU0:STRTSB.COM to DL0:STRTSB.COM
DU0:RT11XM.SYS to DL0:RT11XM.SYS
DU0:DUX.SYS    to DL0:DUX.SYS
DU0:STRTXM.COM to DL0:STRTXM.COM
DU0:DD.SYS     to DL0:DD.SYS
DU0:DDX.SYS    to DL0:DDX.SYS
DU0:V5USER.TXT to DL0:V5USER.TXT
DU0:V5NOTE.TXT to DL0:V5NOTE.TXT
DU0:DL.SYS     to DL0:DL.SYS
DU0:DLX.SYS    to DL0:DLX.SYS
DU0:DYX.SYS    to DL0:DYX.SYS
DU0:DY.SYS     to DL0:DY.SYS
DU0:DQ614P.SAV to DL0:DQ614P.SAV
DU0:RT11SJ.SYS to DL0:RT11SJ.SYS

.COPY /BOOT:DL DL0:RT11XM.SYS DL0:

.BOOT DL0:

RT-11XM  V05.06

.TYPE V5USER.TXT

                                RT-11 V5.6

    Installation  of  RT-11  Version  5.6 is complete and you are now running
    RT-11 from your system volume.

    Your  system volume is your working volume if you have used the Automatic
    Installation (AI) procedure.  If you  have  installed  RT-11  using  that
    procedure,  Digital  recommends  you verify the correct operation of your
    system's software using the VERIFY verification procedure.  You can  only
    perform  VERIFY  on  the  valid target (output) media you used for the AI
    procedure.  Run VERIFY before you run CONFIG.  To run VERIFY,  enter  the
    command:
                                IND VERIFY

    Digital  recommends  you  read the file V5NOTE.TXT, which you can TYPE or
    PRINT.  Also, read the Introduction to RT-11, rewritten for  V5.6,  which
    contains much of the information you need to use RT-11 Version 5.6.


.R MSCPCK

.
```

XEROX Rigid Disk

Xerox Rigid Disk is quite unique. On all other HDD's sector is divided into two Blocks: a Header Block and a Data Block. Data blocks may be written individually, Header blocks are written only during low level formatting. Xerox Rigid Disk sector is divided into three Blocks: a Header Block, a Label Block, and a Data Block. Header blocks are written only during low level formatting, but booth Label Block and Data Block may be written individually. Label Block carry 20 byte payload, Data Block carry regular sector data payload.

```
[DSK]
Name=Xerox 6085
Encoding=MFM
RPM=3600
Tracks=960
Sides=8
Sectors=16
First Sector ID=0
Sector Size=532  ; 512 data + 20 label
Format=XEROX-RIGID
Interleave=1
```

DSK file size should be calculated using sector size increased by 20 bytes, i.e. 512 + 20 = 532 for 512 byte sectors. Label Block data is stored in the first 20 bytes of the DSK file sector.

NOTE: Low Level Format must be executed for new **DSK** files in order to initialize Label Blocks.

DEC 8in RX01/RX02 Compatible Controllers

Some examples of DEC RX01/RX02 compatible controllers for 8in Shugart 50 pin drives:

- Data Systems Design DSD4140
- Dilog DQ419
- Sigma Information Systems SDC-RXV21 SDC-RXV31
- Micro Development Associates MDS MXV21
- AED FLEX0

FM and M2FM (MMFM) modes are supported. Shugart 50pin for FDD passive conversion header should be used as described in this manual. DREM provides signal `/TWO SIDED`, so double side operation is possible when using a special DY.SYS driver from the controller card manufacturer. In order to boot from RX02 drive please set in DREM2.INI :

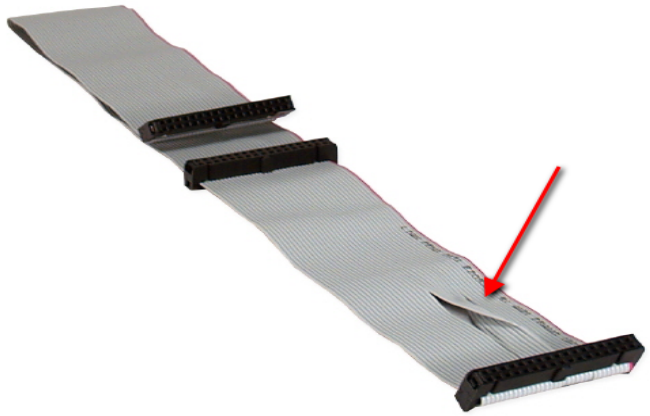
```
L2 Preload=YES
L2 Preload Timeout=0
RAM Allocation Order=ABCD0123
```

More information about controllers mentioned above may be found here:
http://avitech.com.au/?page_id=847

Interface and Cable Keys Explained

Cable=STRAIGHT and Cable=TWISTED

DREM may be connected to an FDD controller using a regular *STRAIGHT* cable or PC **TWISTED** cable. To ensure correct operation the **Cable** key must be set to **Cable=STRAIGHT** or **Cable=TWISTED**



The wires that are cross-connected via the twist are signals 10 to 16 (seven wires). Of these, 11, 13, and 15 are ground and carry no signal, so there are really four signals that are inverted by the twist.

Fragment of **STRAIGHT** cable pinout

```
Pin    Name         Pin
10     /MOTEA-->    10
12     /DRVSB-->    12
14     /DRVSA-->    14
16     /MOTEB-->    16
```

Fragment of **TWISTED** cable pinout

```
Pin    Name         Pin
10     /MOTEA-->    16
12     /DRVSB-->    14
14     /DRVSA-->    12
16     /MOTEB-->    1
```

Interface=SHUGART

Distinctive characteristics of the **SHUGART** interface:

- Four Drive Select lines
- Single common Motor line
- Pin 2 - Disk Change Detect from FDD to computer
- Pin 34 – Drive Ready Line

Pin	Name	Dir	Description
2	/DCD	<--	Disk Change Detect
3	Key		no pin in this position
6	/DS3		Device Select 3.
4	/INUSE		
8	/INDEX	<--	Index
10	/DS0	-->	Device Select 0
12	/DS1	-->	Device Select 1
14	/DS2	-->	Device Select 2
16	/MTRON	-->	Motor On
18	/DIR	-->	Direction
20	/STEP	-->	Step
22	/WDATA	-->	Write Data
24	/WGATE	-->	Floppy Write Enable
26	/TRK00	<--	Track 0
28	/WPRT	<--	Write Protect
30	/RDATA	<--	Read Data
32	/SIDE1	-->	Head Select
34	/RDY	<--	Drive Ready/Disk Changed

Interface=IBM-PC

Distinctive characteristics of the **IBM-PC** interface:

- Two Drive Select lines
- Two Motor lines
- Drive Select and Motor line arrangement enable swapping drives A & B using a **TWISTED** cable
- Pin 2 - Density Select from computer to FDD. In PS/2 mode 1=Low(Bitrate=250 or 300) 0=High(Bitrate=500 or 1000)
- Pin 34 - Drive Ready / Disk Change line

Pin	Name	Dir	Description
2	/DENSEL	-->	Density Select
4	n/c		Reserved
6	n/c		Reserved
8	/INDEX	<--	Index
10	/MOTEA	-->	Motor Enable A
12	/DRVSB	-->	Drive Sel B
14	/DRVSA	-->	Drive Sel A
16	/MOTEB	-->	Motor Enable B
18	/DIR	-->	Direction
20	/STEP	-->	Step
22	/WDATA	-->	Write Data
24	/WGATE	-->	Floppy Write Enable
26	/TRK00	<--	Track 0
28	/WPRT	<--	Write Protect
30	/RDATA	<--	Read Data
32	/SIDE1	-->	Head Select
34	/DSKCHG	<--	Disk Change/Ready

Interface=AMIGA

Distinctive characteristics of the **AMIGA** interface:

- Two different connectors: Internal and External
- Internal connector has 2 Drive Select lines DF0:, DF1: and single MOT0 line with Flip-Flop on motherboard
- External connector has 3 Drive Select lines DF1:, DF2:, DF3: and single MOTX line, which in combination with external Flip-Flops enable individual motor control
- Pin 2 - Disk Change Detect from FDD to computer
- Pin 34 - Drive Ready /Serial Out in Drive Identification Mode
- Drive Identification Mode using special serial protocol and combination of motor, ready and drive select lines

DREM supports AMIGA drive identification mode. It is possible to connect DREM to an Internal or External Amiga FDD connector. For External connect, a special cable is required (not included).

If DREM is connected to an Amiga Internal FDD connector it will respond as DF0: (A:) and DF1:(B:). Use of DF0: is straightforward, use of DF1: may require expert knowledge of Amiga and may require a different configuration for different Amiga models.

Pin	Name	Dir	Description
2	/CHNG	-->	Disk Change Detect
3	Key		no pin in this position
6	n/c		Reserved
4	/INUSE	-->	In Use LED (Connected to Pin 16 /MTR0 on motherboard)
8	/INDEX	<--	Index
10	/ SEL0	-->	Device Select 0
12	/ SEL1	-->	Device Select 1
14	n/c		Reserved
16	/MTR0	-->	Motor On Drive 0 (with Flip-Flop on motherboard)
18	/DIR	-->	Direction
20	/STEP	-->	Step
22	/DKWD	-->	Write Data
24	/DKWE	-->	Floppy Write Enable
26	/TK0	<--	Track 0
28	/WPRO	<--	Write Protect
30	/DKRDY	<--	Read Data
32	/SIDE1	-->	Head Select
34	/RDY	<--	Drive Ready/Serial Out in Drive Identification Mode

For use DF1: on internal FDD connector

Amiga 2000	J301 must be on.
Amiga 3000D	J351 must be shortened between 1-2.

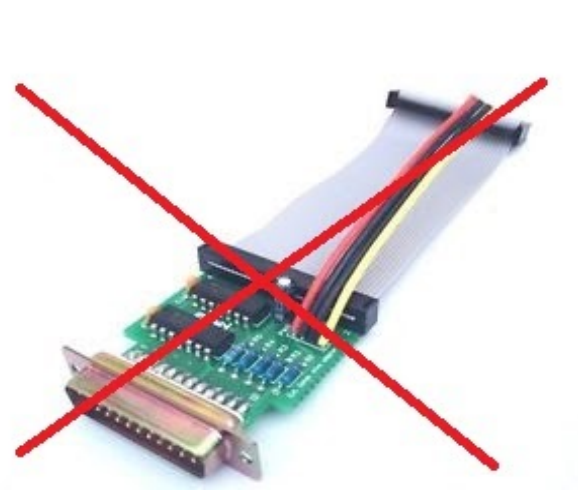
Amiga 3000T	J351 must be shortened between 1-2.
Amiga 4000	J351 closed: enable 2nd internal floppy 880 KB
	J351 open: no 2nd internal floppy, or 1.76MB floppy

If DREM is connected to the Amiga External FDD connector it will respond as DF1: (B:) and DF2:(C:) and DF3:(D:). If you like to boot your Amiga from an external floppy – you need *Kickstart v2.0* or better. From *Kickstart* release 2.0 onwards it is possible to enter "Amiga Early Startup Control" by holding down both mouse buttons at power on or reset. This allows the user to choose a boot device.

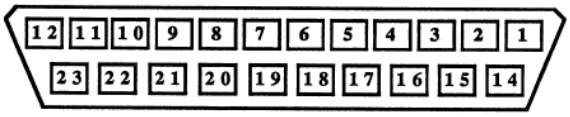
NOTE: If DREM is connected to the Amiga External FDD connector, then for proper drive identification, during Amiga boot up process you have three options:

1. If DREM is powered from dedicated external power supply:
    - Power up DREM
    - Wait till DREM beeps twice
    - Power up Amiga
2. If DREM is powered from Amiga:
    - Power up Amiga and wait till AmigaDOS is loaded
    - Reboot AmigaDOS by clicking *Run -> System -> Reboot*
3. If DREM is powered from Amiga and your Amiga have *Kickstart* release 2.0 installed:
    - Hold down both mouse buttons and power up Amiga
    - Wait till DREM beeps twice
    - Click *Boot* on "Amiga Early Startup Control" screen

TIP: Ready to use cables are available on eBay from third party suppliers. Before making a purchase, make sure that you choose a plain cable without any electronic components and re-confirm cable wiring with the vendor as per picture above.



External Amiga FDD DB23 Female:



DB-23 female

Cable for connecting DREM to AMIGA external FDD connector:

Amiga External FDD		**DREM**	
Pin	**Description**	**Pin**	**Description**
1	/RDY	34	/RDY
2	/DKRD	30	/RDATA
3	GND	19	GND
4	GND	21	GND
5	GND	23	GND
6	GND	25	GND
7	GND	29	GND
8	/MTRX	16	/MTRON
9	/SEL2[1]	14	/DS2
10	/DRES		
11	/CHNG	2	/CHNG
12	+5V		
13	/SIDE	32	/SIDE1
14	/WPRO	28	/WPRT
15	/TK0	26	/TRK00
16	/DKWE	24	/WGATE
17	/DKWD	22	/WDATA
18	/STEP	20	/STEP
19	/DIR	18	/DIR
20	/SEL3[2]	6	/DS3
21	/SEL1[3]	12	/DS1
22	/INDEX	8	/INDEX
23	+12V		

[1] A2000 /SEL3 to DREM Pin 6
[2] A2000 not used
[3] A2000 /SEL2 to DREM Pin 14

NOTE: no Flip-Flops required, they are implemented inside DREM.

Interface ST-506 and ST-412

The ST-412 interface will be selected automatically for bit rates higher than 1000.

Control Connector

Pin	Description	Pin	Description
1	GND	2	/HEAD8 or /RWC or /CHANGE_CARTRIDGE[1]
3	GND	4	/HEAD4
5	GND	6	/WGATE
7	GND	8	/SEEK_COMPL
9	GND	10	/TR0
11	GND	12	/WR-FAULT
13	GND	14	/HEAD0
15	GND	16	N/C or /RECOVERY_MODE
17	GND	18	/HEAD2
19	GND	20	/INDEX
21	GND	22	/READY
23	GND	24	/STEP
25	GND	26	/DS0
27	GND	28	/DS1
29	GND	30	/DS2
31	GND	32	/DS3
33	GND	34	/DIR

Data Connector

Pin	Description	Pin	Description
1	/DS	2	GND
3	RECALIBRATE[1]	4	GND
5	/WRITE_PROTECTED[1] [2] *	6	GND
7	N/C	8	N/C
9	/CARTRIDGE_CHANGED[1] *	10	/CARTRIDGE_IN[1] *
11	GND	12	GND
13	+WR-DATA	14	-WR-DATA
15	GND	16	GND
17	+RD-DATA	18	-RD-DATA
19	GND	20	GND or /RADIAL_INDEX[1]

[1] Signals used by removable cartridge HDD's like Syquest SQ312RD and similar.

[2] Signal is used in Radio Shack computers.

* DREM Rev.2 and higher.

HP-86A interface for HP 9130A floppy

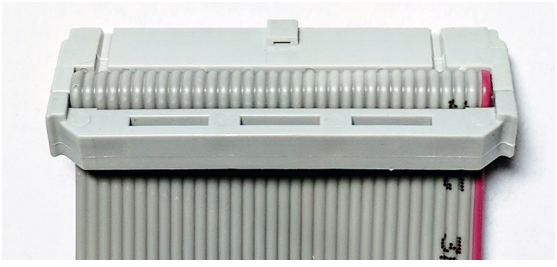
Centronics 36pin

Pin	Description	Pin	Description
19	+12V	1	+5V
20	+12V	2	+5V
21	+12V	3	+5V
22	+12V	4	+5V
23	+12V	5	GND
24	+12V	6	GND
25	GND	7	GND
26	GND	8	/DS
27	GND	9	/INDEX
28	GND	10	/MTRON
29	GND	11	/DIR
30	GND	12	/STEP
31	GND	13	/WDATA
32	GND	14	/WGATE
33	GND	15	/TRK00
34	GND	16	/WPRT
35	GND	17	/RDATA
36	GND	18	/SIDE1

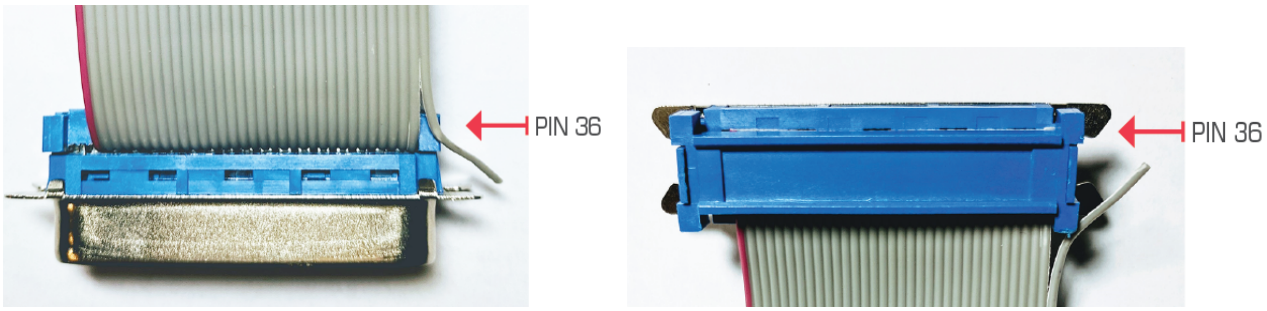
NOTE: HP-86A interface does not have /READY signal. DRIVE 0 connector carry /DS0 signal and DRIVE 1 connector carry /DS1 signal.

Besides the seemingly complicated pinout, making a connection cable is quite an easy task. You will need to solder only a few wires.

1. Use 34 conductor ribbon cable and crimp on the IDC connector as usual.



2. Cut wire #34 on the Centronics side. Crimp on the Centronics connector while aligning the wire #33 with Centronics connector Pin 36.



3. Cut the ribbon cable wires #1 to #15
4. Connect wire #8 on IDC side to wire #14 on the Centronics side.
5. Connect wire #10 on IDC side to wire #12 on the Centronics side.
6. +5V power may be drawn on Centronics side from wires #2 and #4 and the Ground from wires #6, #8 and #10

LIF format (HP's Logical Interchange Format) is RAW DSK images compatible with DREM. Such images come e.g. with Everett Kaser's Series-80 computer emulator http://www.series80.org/ . Files without extension or files with extension LIF must be renamed to have DSK extension before using with DREM.

```
[DSK]
Name=HP9130A
Encoding=MFM
Tracks=35
Sides=2
Sectors=16
First Sector ID=0
Sector Size=256
GAP1=106
GAP2=23
GAP3=44
Interleave=6
Track Skew=10
Side Skew=13
Cable=STRAIGHT
Interface=SHUGART
```

NOTE: Config file above is for 35 track DSK files of 286,720 bytes. HP format uses 2 spare tracks per side so that 33 remain for payload. Emulator LIF files are 33 track files 270,336 bytes long. DREM will produce a warning message, but it is OK to use shorter files for reading and writing.

HP 9153 A/B/C floppy

Pin	Description	Pin	Description
1	/CHNG-RES	2	/CHNG
3	+5V	4	/LED
5	+5V	6	/DS3
7	+5V	8	/INDEX
9	+5V	10	/DS0
11	+5V	12	/DS1
13	GND	14	/DS2
15	GND	16	/MTRON
17	GND	18	/DIR
19	GND	20	/STEP
21	GND	22	/WDATA
23	GND	24	/WGATE
25	GND	26	/TRK00
27	GND	28	/WPRT
29	+12V	30	/RDATA
31	+12V	32	/SIDE1
33	+12V	34	/RDY

How to make a cable:

1. Take regular IDC 34 to ISC 34 floppy cable
2. Using X_ACTO knife carefully separate and cut wires ## 1, 3, 5, 7, 9, 11, 29, 31, 33
3. For drawing +5V power from HP 9153 use wires ## 3, 5, 7, 9, 11 for ground, cut and use wires ## 13, 15.

NeXT floppy (Media Sense Drives)

Pin	Description	Pin	Description
1	/EJECT --> Eject	2	/DENSEL1 --> Density Select 1
3	N/C	4	/DRVID <-- Drive ID
5	+5V	6	/DENSEL0 --> Density Select 0
7	+5V	8	/INDEX
9	+5V	10	/DS0
11	+5V	12	/DS1
13	GND	14	/DS2
15	GND	16	/MTRON
17	/MID1 <-- Media Type ID1	18	/DIR
19	GND	20	/STEP
21	GND	22	/WDATA
23	GND	24	/WGATE
25	GND	26	/TRK00
27	/MID0 <-- Media Type ID0	28	/WPRT
29	GND	30	/RDATA
31	GND	32	/SIDE1
33	GND	34	/DSKCHG <-- Disk Change

NOTE: DREM may be powered from NeXT via FDD cable. For drawing +5V power from NeXT **CLOSE** J100 jumper pins 1-2 and disconnect any other power connectors from DREM.

ATTENTION: OPEN J100 jumper before connecting DREM to any other type of host system.

Osborne 1 floppy

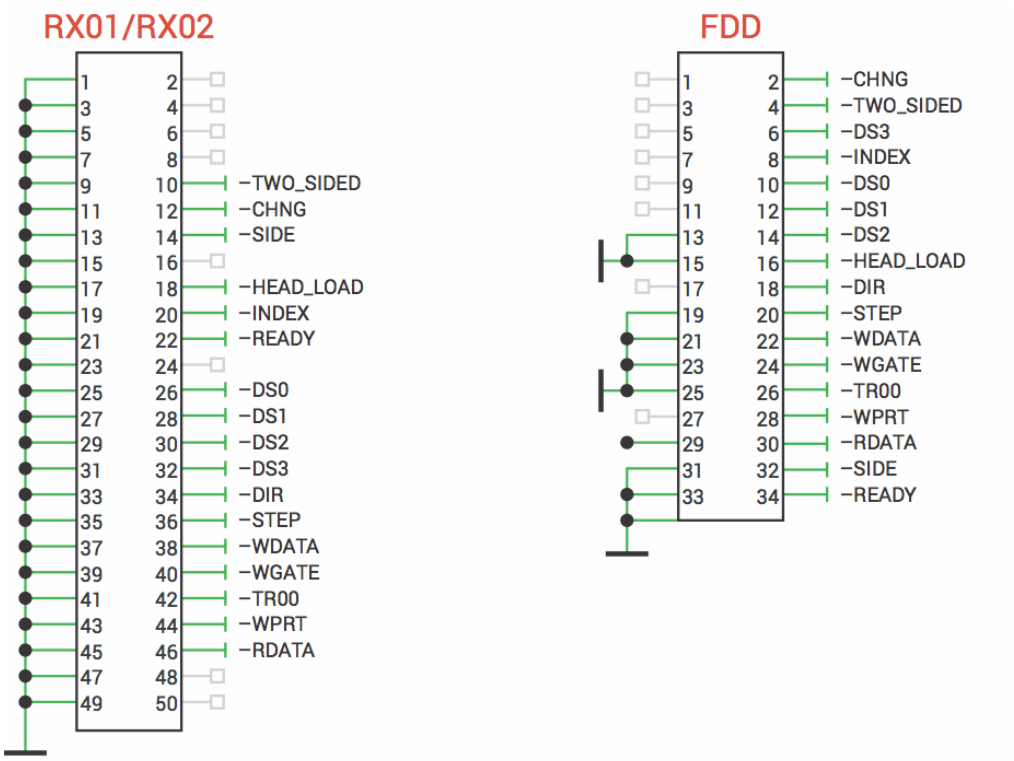
Pin	Description	Pin	Description
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	GND	8	/INDEX
9	GND	10	/DS0
11	+12V	12	/DS1
13	+12V	14	N/C
15	+12V	16	4MHz Clock
17	+12V	18	/DIR
19	GND	20	/STEP
21	+5V	22	/WDATA
23	+5V	24	/WGATE
25	+5V	26	/TRK00
27	GND	28	/WPRT
29	GND	30	/RDATA
31	GND	32	/SIDE1
33	GND	34	/LATE

NOTE: DREM may be powered from Osborne 1 via FDD cable. For drawing +5V power from Osborne 1 **CLOSE** J100 jumper pins 2-3, **CLOSE** jumper J101 and disconnect any other power connectors from DREM.

ATTENTION: OPEN J100 and J101 jumpers before connecting DREM to any other type of host system.

Shugart 50-pin

Shugart 50-pin interface may be connected to DREM using simple passive connector header.



PCB design CAD file is included in the software package for your convenience.

JVC 26pin HDD Interface

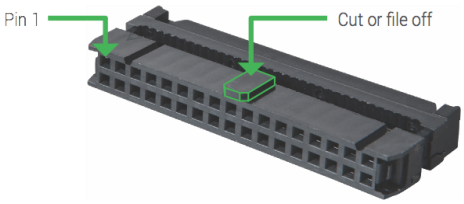
Pin	Description	Pin	Description
1	GND	2	/RDATA
3	GND	4	/WDATA
5	GND	6	/HEAD2
7	/DS	8	/SHIP_READY
9	GND	10	/WGATE
11	/MTRON	12	/HEAD0
13	/DIR	14	/STEP
15	/WRITE_FAULT	16	/SEEK_COMPL
17	/SERVO_GATE	18	/INDEX
19	/TRK0	20	/READY
21	GND	22	+5V
23	GND	24	+5V
25	GND	26	+12V

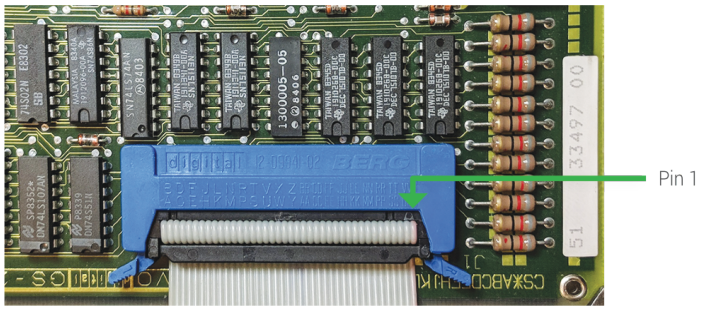
ATTENTION: DREM draws power directly from JVC 26pin cable. Do not connect power via MOLEX connectors.

DEC RLV

Interface=DEC-RLV is compatible with DEC RLV12, RLV11, RL11 and RL8 controllers.

NOTE: DEC RLV connectors have no cable key. You may need to cut off or file off the key on the cable connector and pay close attention to cable orientation.

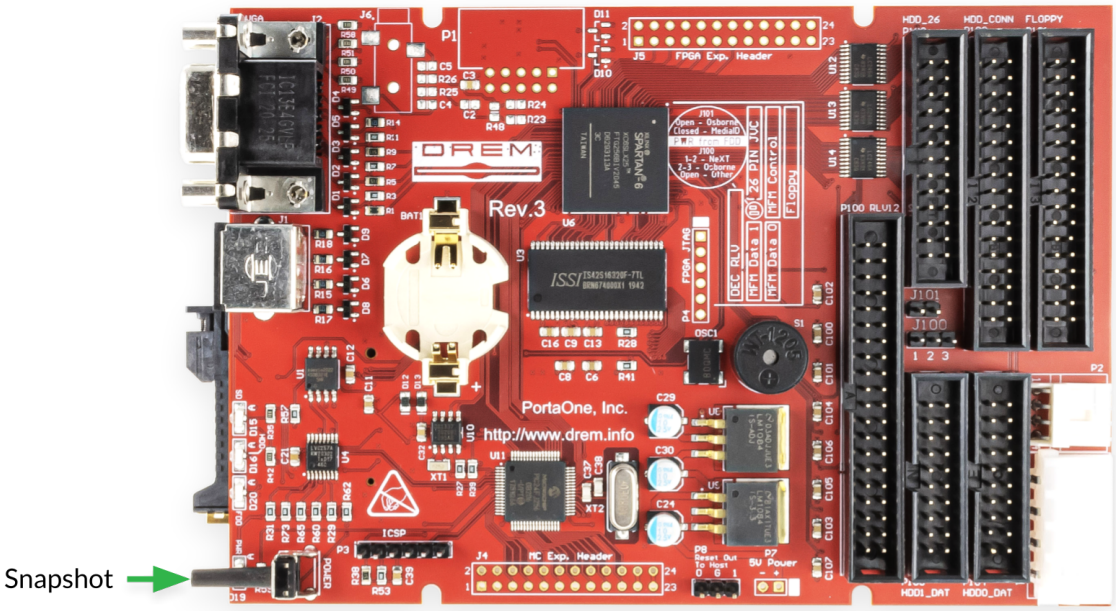




Description	DREM Pin	RLV Pins	DREM Pin	Description	Direction
GND	1	VV UU	2	Power OK	--> RL
Drive Select 0 3	TT	SS 4	Drive Select 0		--> RL
Drive Select 1	5	RR PP	6	Drive Select 1	--> RL
Write Gate	7	NN MM	8	Write Gate	--> RL
GND	9	LL KK	10	GND	
System Clock	11	JJ HH	12	System Clock	--> RL
GND	13	FF EE	14	GND	
Write Data	15	DD CC	16	Write Data	--> RL
GND	17	BB AA	18	GND	
Drive Command	19	Z Y	20	Drive Command	--> RL
Read Data	21	X W	22	Read Data	<-- RL
GND	23	V U	24	GND	
Status In	25	T S	26	Status In	<-- RL
GND	27	R P	28	GND	
Status Clock	29	N M	30	Status Clock	<-- RL
GND	31	L K	32	GND	
Sector Pulse	33	J H	34	Sector Pulse	<-- RL
Drive Ready	35	F E	36	Drive Ready	<-- RL
Drive Error	37	D C	38	Drive Error	<-- RL
GND	39	B A	40	GND	

Making backup copies: Snapshot feature

Pressing and holding Snapshot Button in Console mode creates instant copy of DSK disk images without interrupting host computer current disk operations.



Snapshot is an instant copy of a DSK file. Snapshot file is located in the same directory as DSK file and file name includes original DSK file name and timestamp. For instance for file

default0.dsk

snapshot file name looks like:

default0.dsk - 14 Jan 2019 10-07-19.dsk

In order to set up automatic backups use **DREM2.INI** option Auto Snapshot Interval (30 or more minutes) in combination with CFG option Snapshot Enabled (YES or NO).

Using VGA monitor and PS/2 keyboard

DREM is equipped with a VGA output, PS/2 keyboard/mouse input and file manager software. Users can browse an SD card and insert DSK images into virtual drives. The use of a monitor and keyboard is optional, all DREM user interface functions may be accessed using Snapshot button or static startup configuration from **/drem2.ini** file may be used.
With an optional VGA monitor and keyboard users may access a live transaction log and monitor drive activity in great detail. At any time a user may start or stop capturing log data into a file on an SD card, which is very useful for analyzing low level format information. DREM comes with many CFG files for many frequently used host computers. However if you are not quite sure about the low level format for a particular host, DREM will provide some analysis and clues in the log file captured during low level format operations.

Using **DREM2.INI** options:

```
[start-up]
start menu                    = YES

[menu]
enabled                       = YES
timeout (sec)                 = 0
restart from top level        = NO
exit enabled                  = NO
status line enabled           = NO
mnu file                      = /ROOT.MNU
```

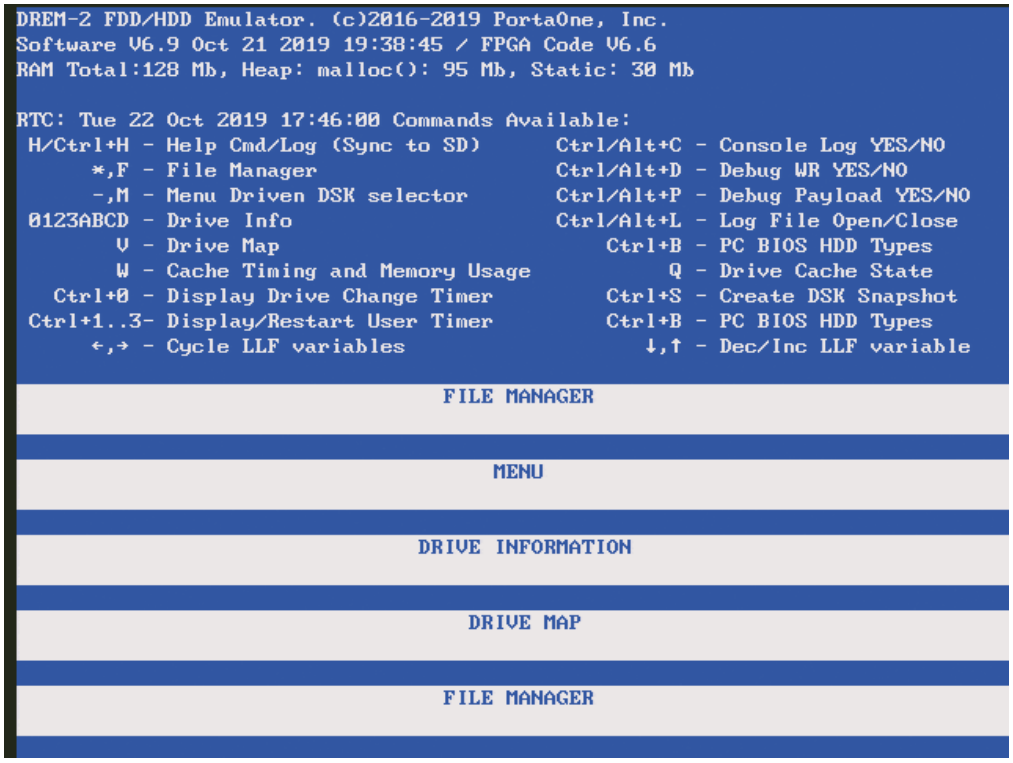
DREM user interface may be locked to use the Menu system only.

User Interface Concept

DREM user interface has five distinctive modes:

- Console
- File Manager
- Menu
- Drive Information
- Drive Map

Mode switching is either direct, using a keyboard, or sequential using a snapshot button.



Snapshot Button Functions:

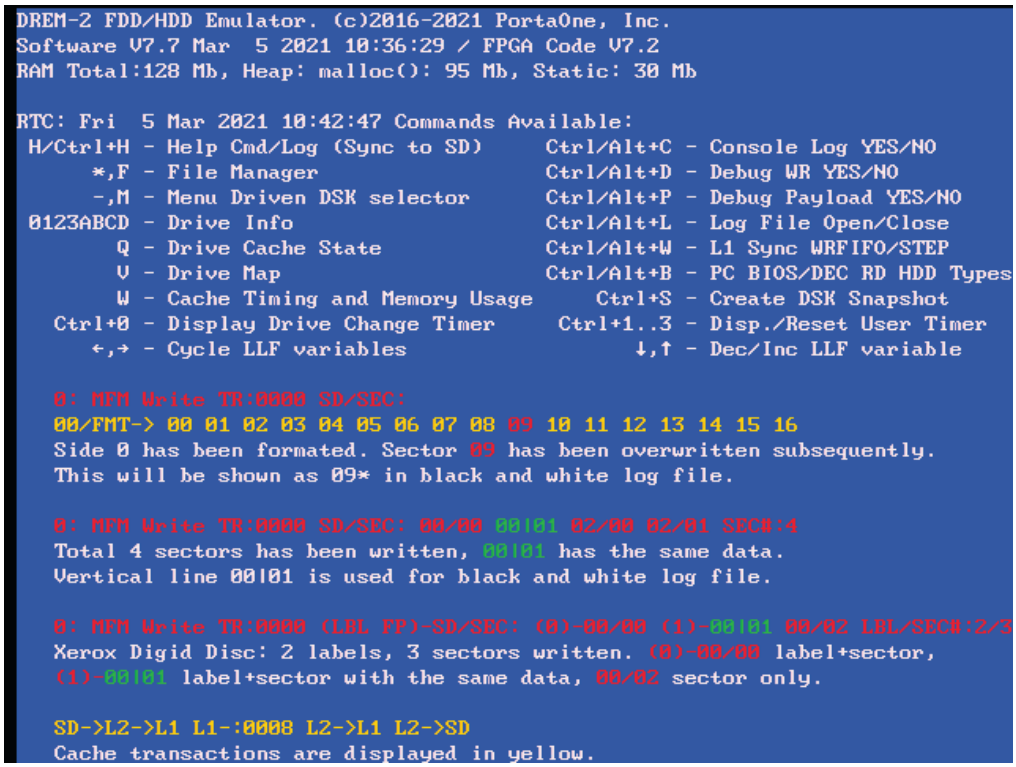
Click	Select next desirable mode: File Manager, Menu, Drive Info, Drive Map
Double Click	Enter mode selected
Hold	Snapshot

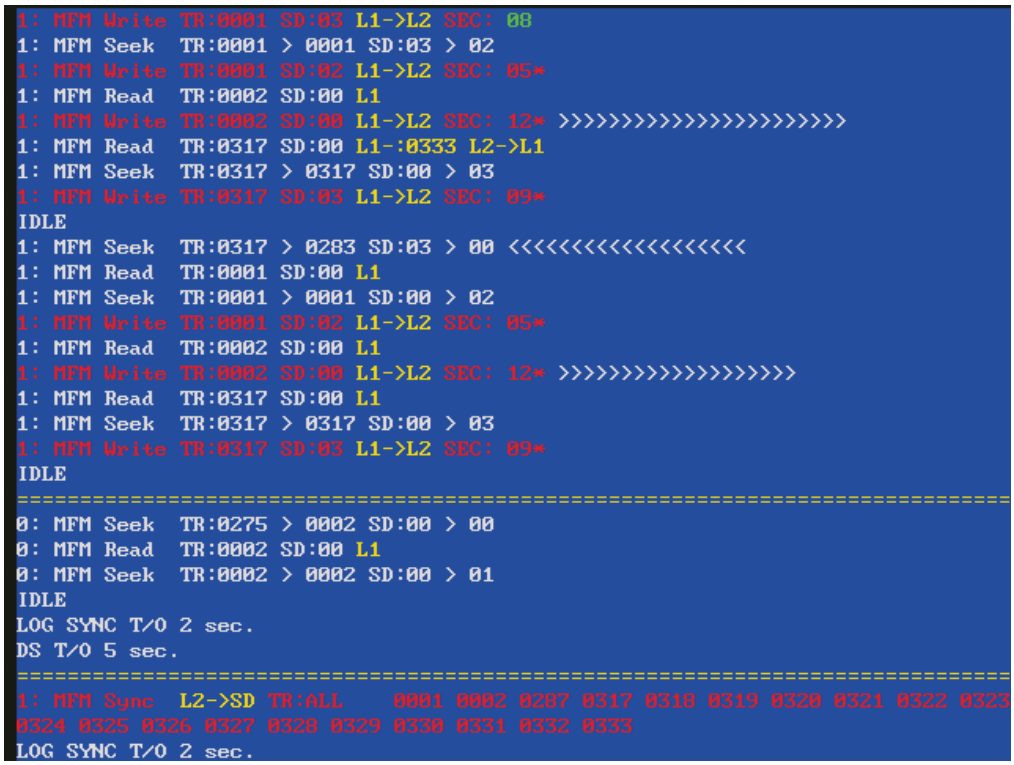
Keyboard commands are designed in order to facilitate any-to-any mode transition using the same keys:

ESC	Console	
F	File Manager	(**0123ABCD** - Select Drive, **I** - Drive Info)
M	Menu	
0123ABCD	Drive Info	
V	Drive Map	(**0123ABCD** - Select Drive, **I** - Drive Info)

Console mode

DREM enters console mode on power up. Console mode is used to access the activity log, error messages and usage statistics.





File Manager Mode

Snapshot Button Functions:

Hold	Switch between File Manager windows: Files, Drives, Help.

Files Window

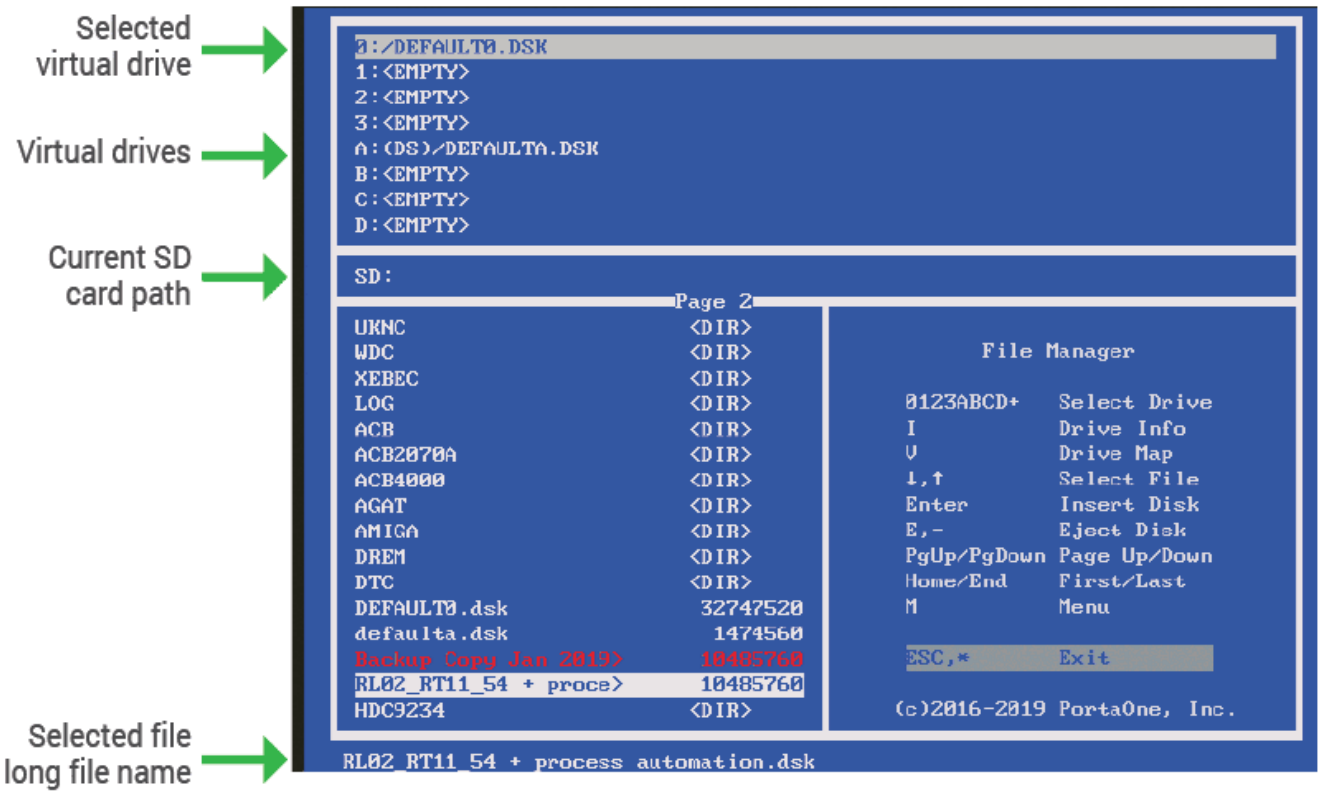
Click	Next file
Double Click	Select file
Hold	Go to Drives window

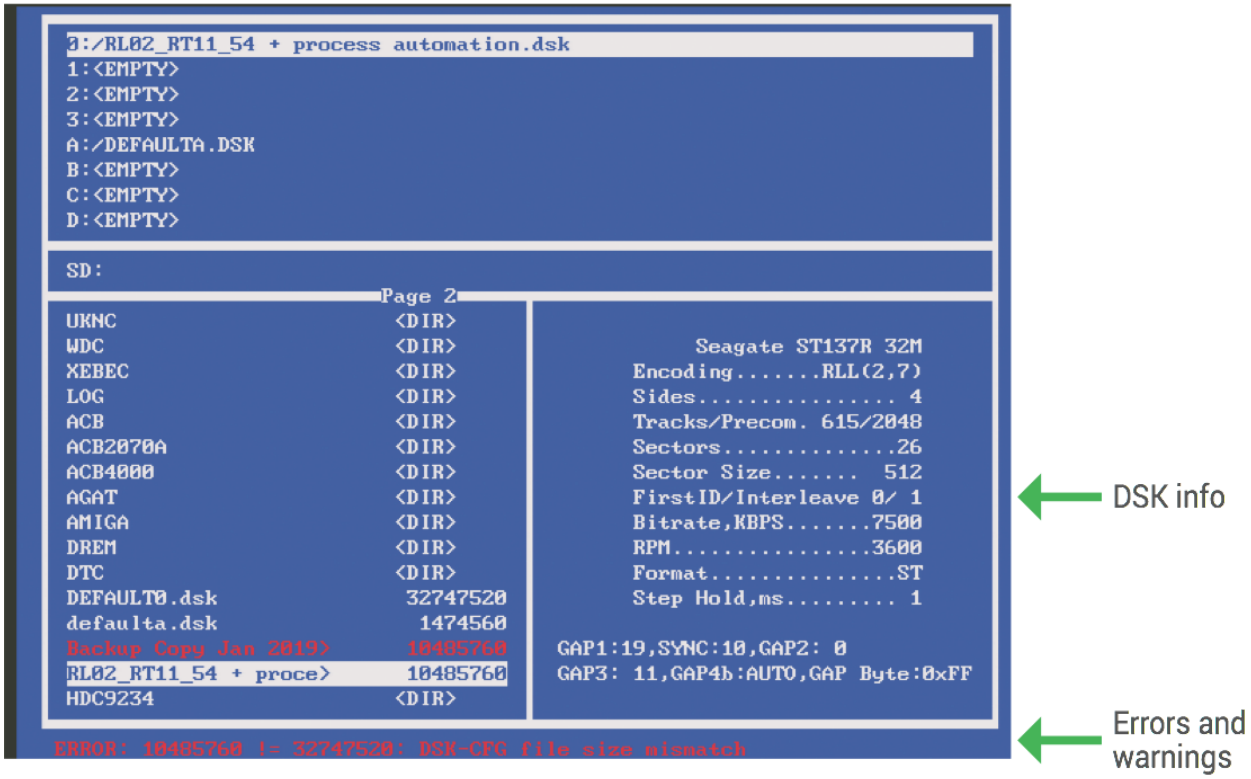
Drives Window

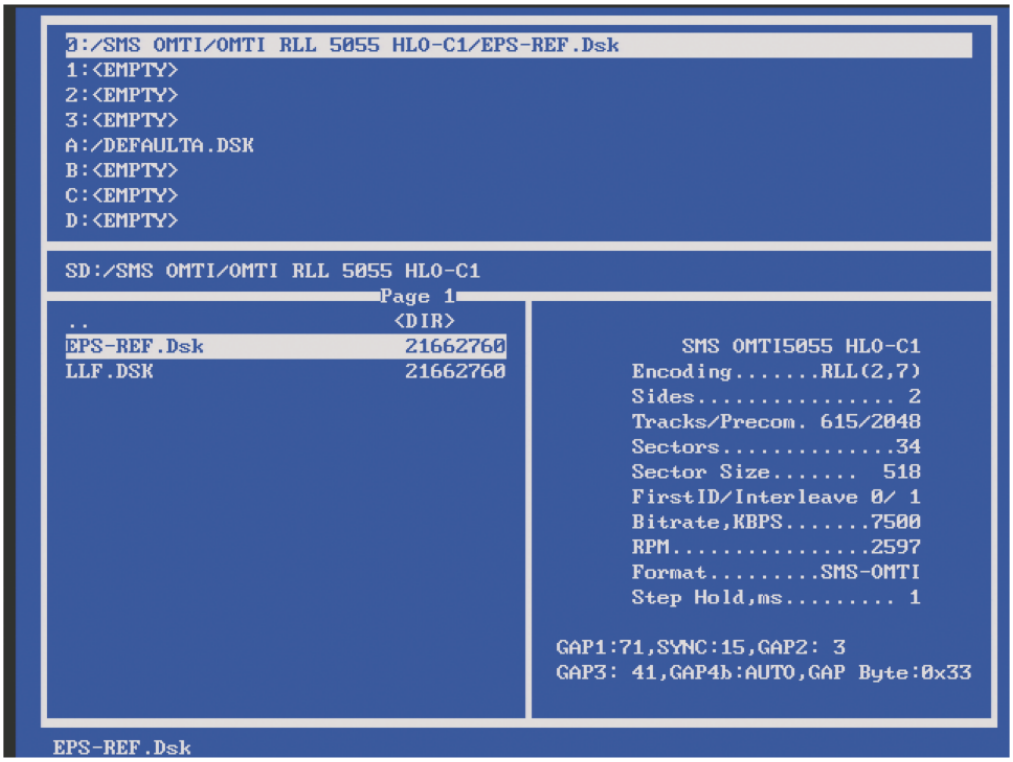
Click	Next drive
Double Click	Eject
Hold	Go to Help window

Help Window

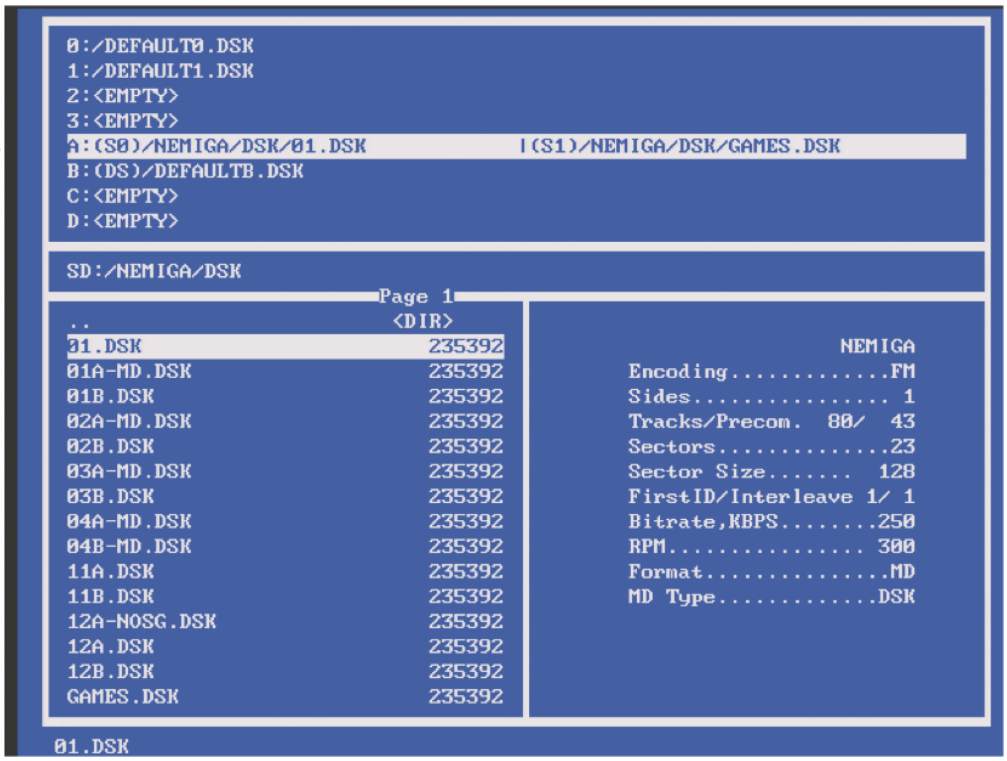
Double Click	Exit to Console mode
Hold	Go to Files Window







Two single sided disk images in one virtual drive



Menu Mode

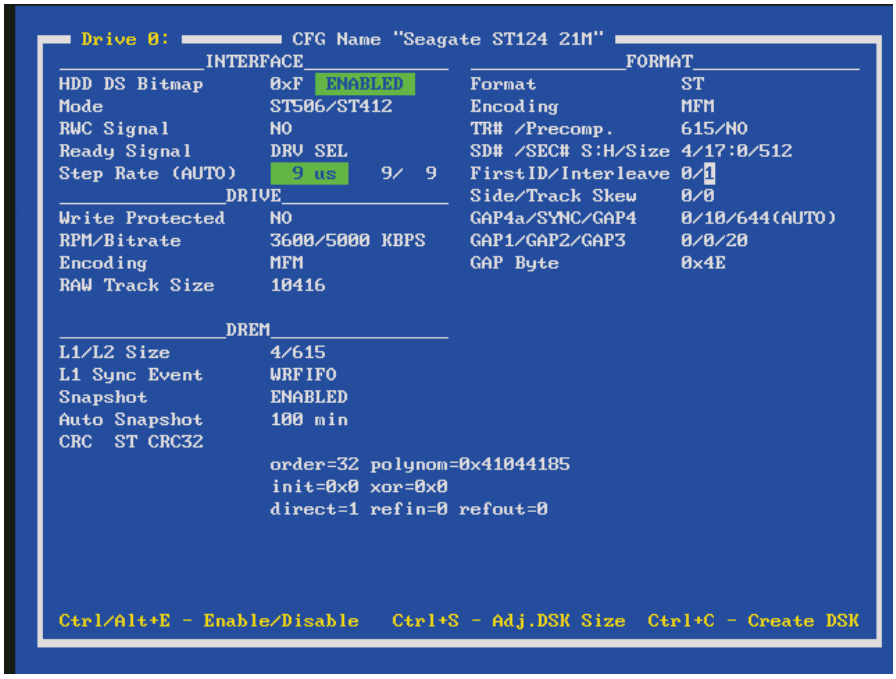
Snapshot Button Functions:

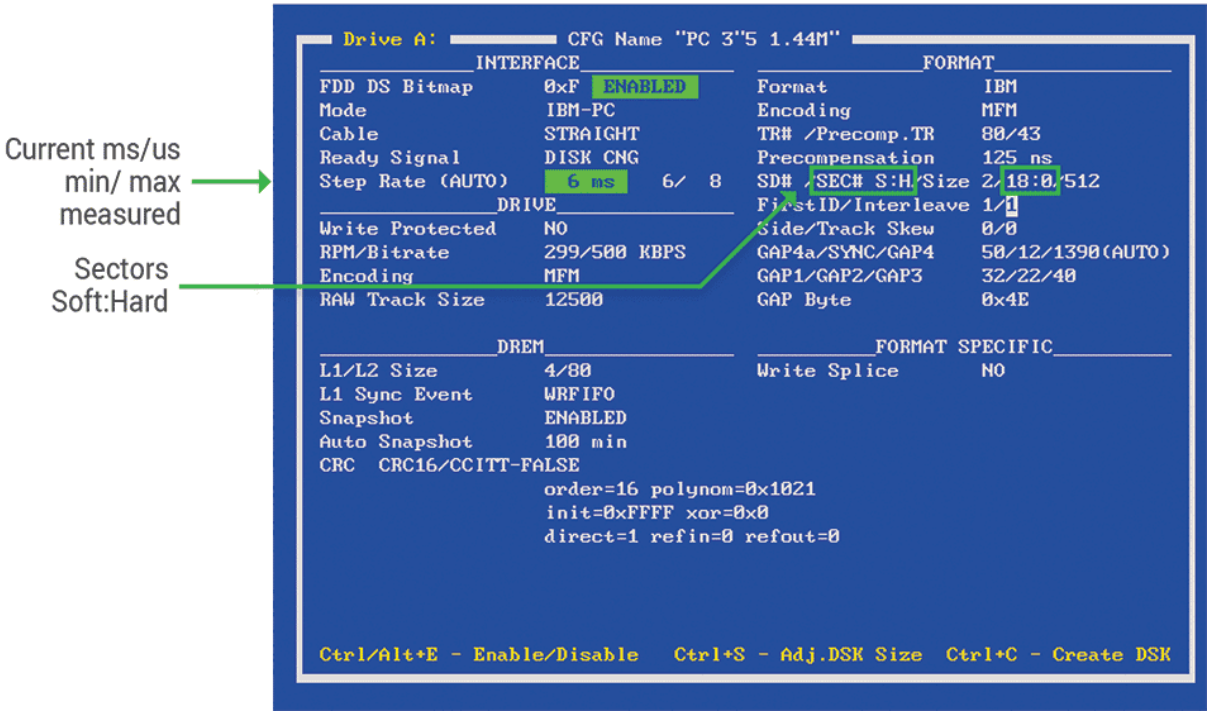
Click	Next item
Double Click	Select Item
Hold	Exit to Console mode

Drive Info Mode

Snapshot Button Functions:

Click	Next Drive
Hold	Exit to Console mode

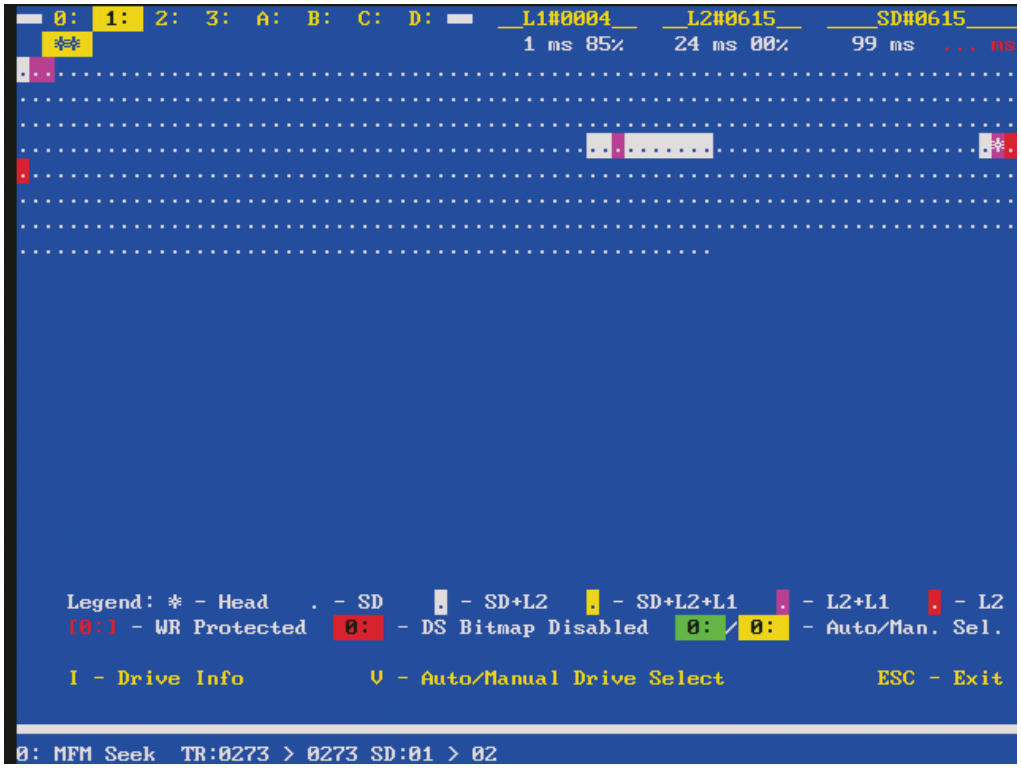




Map Mode

Snapshot Button Functions:

Click	Next Drive, Auto switch off
Double Click	Toggle Auto switch mode on/off
Hold	Exit to Console mode



Menu Files

For user convenience **DSK** files may be selected via file manager or user configurable menus. One menu may have up to 10 items. Each menu item may cause load of **DSK** into a specific drive or opening of another **MNU** file. When the user presses **M** in console mode, DREM will open the **MNU** file as defined by the **Menu File** key in file **/DREM2.INI** (Default is **/ROOT.MNU**).

MNU file has very simple structure:

```
Line 1: Menu Name (Up to 70 characters)
Line 2: Menu Item #1 (Up to 60 characters)
Line 3: <DRIVE LETTER>:<DSK or MNU file full path name for Menu Item #1>
        (Up to 767 characters)
…….
Line 20: Menu Item #10 (Up to 60 characters)
Line 21: <DRIVE LETTER>:<DSK or MNU file full path name for Menu Item #10>
         (Up to 767 characters)
```

This simple, yet efficient system allows easy creation of descriptive nested menus for loading **DSK** files. To select menu items press number keys **1..9,0**. Pressing **Ctrl+F** reveals file names corresponding to menu items.

Using **DREM2.INI** options

```
[start-up]
start menu                    = YES

[menu]
enabled                       = YES
timeout (sec)                 = 0
restart from top level        = NO
exit enabled                  = NO
status line enabled           = NO
mnu file                      = /ROOT.MNU
```

DREM user interface may be locked to use the Menu system only.

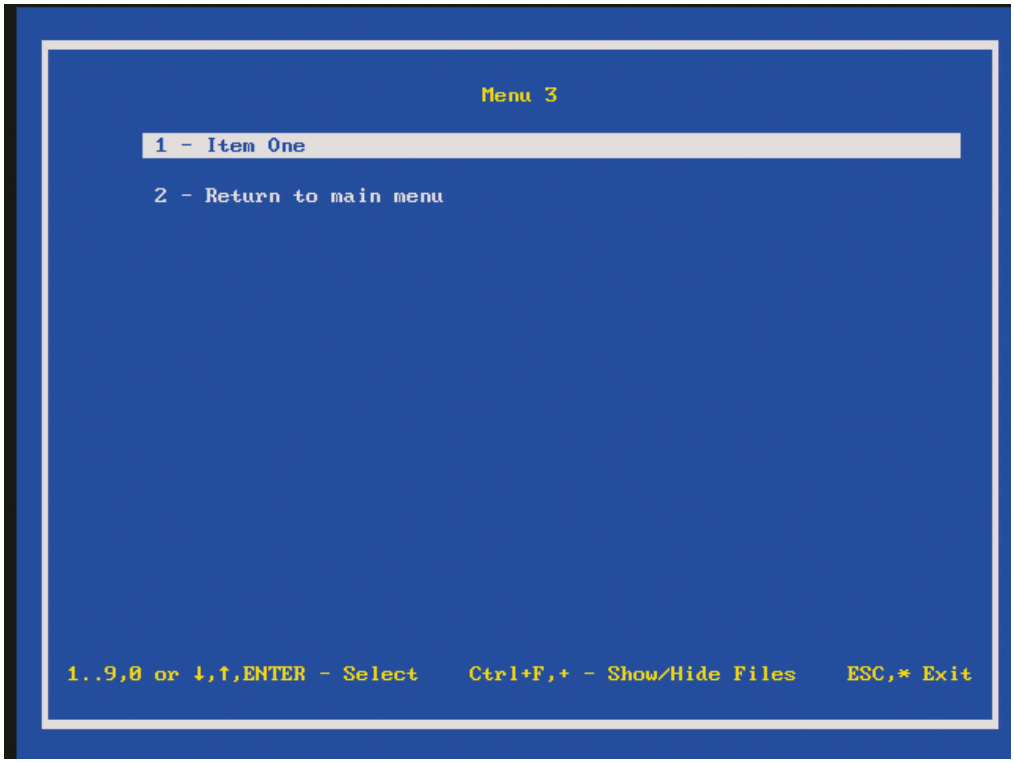
Example of **/ROOT.MNU** file:

```
DREM ROOT Test Menu
Item One
A:/defaulta.dsk
Item Two
b:/defaultb.DSK
Item Three -> Go to Menu 3
/menu3.mnu
Item Four
0:/file4.dsk
Item Five
0:/file5.dsk
Item Six
0:/file6.dsk
Item Seven
0:/file7.dsk
Item Eight
0:/file8.dsk
Item Nine
0:/file9.dsk
Item Ten
0:/file10.dsk
```

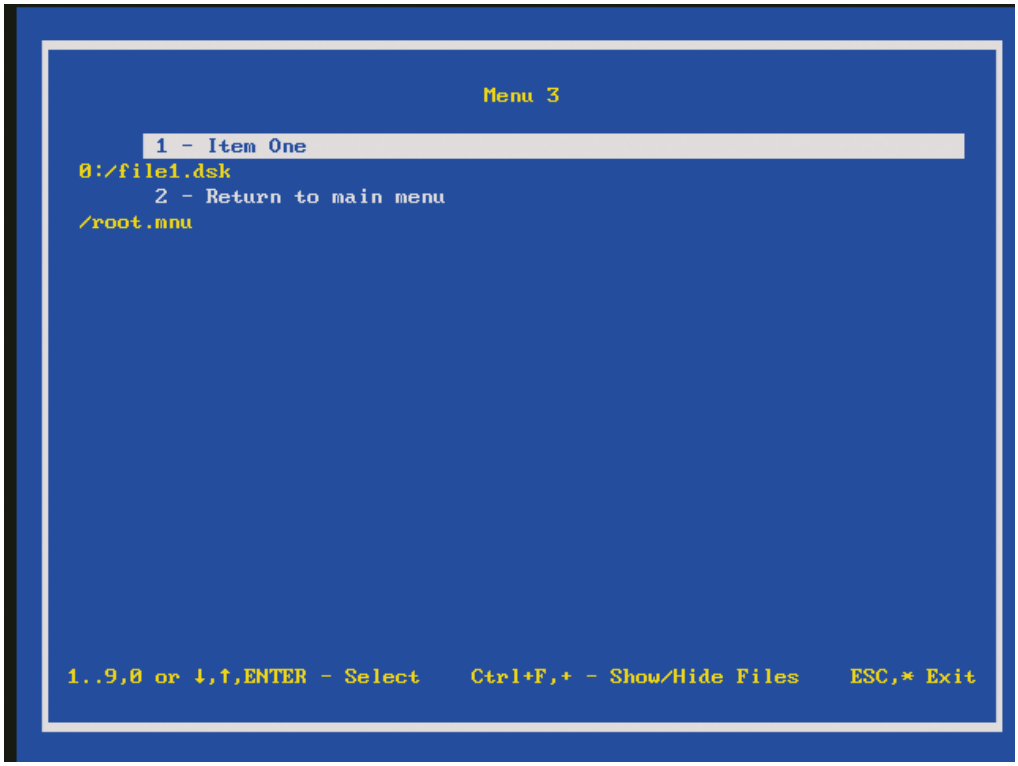
Pressing **3** takes the user to the next menu page, which is stored in the **/MENU3.MNU** file.

Example of **/menu3.mnu** file:

```
Menu 3
Item One
0:/file1.dsk
Return to main menu
/root.mnu
```



Pressing **Ctrl+F** reveals file names corresponding to menu items. Press **Ctrl+F** again to hide file names.



Log Files

Users can start and stop recording a console screen message flow into the log files on the SD card at any time. To open a log file press **Ctrl+L**. To close log file press **Alt+L**. Log files are stored in **/LOG** directory, i.e.:

```
/LOG/DREM - 14 Jan 2019 10-07-19.log
```

Cache Statistics

In order to minimize SD card R/W operations and increase virtual drive performance DREM uses a two level cache and CRC cache. Cache space is allocated dynamically when the DSK is loaded into the virtual drive. L1 & L2 cache size depends on raw track size for requested LLF.

By pressing **Q** and **W** users may access detailed cache state and usage information.

Timers

DREM has four built-in timers for benchmarking purposes. Timer **0** is special: it is reset automatically every time the host computer selects a different drive. Timers **1**, **2** and **3** are general purpose timers.

Appendix 1. BIOS Disk Types

DREM has a PC AT BIOS Disk Types table built in. By pressing **B** in console mode you may obtain table print out with type suggestions for DREM HDD drives. DREM compares only the number of Tracks, Sides and Sectors and does not take into account write precompensation track number, therefore more than one BIOS type may be suggested for the same DREM drive.

The original AT BIOS (01/10/84) has types 1-14. Later versions also have types 16-N with N=23 (AT, 11/15/85) or N=24 (XT), or N=33, or N=44.

Type	Cycls	Hds	WPC	Sectors	Capacity
1	306	4	128	17	10.2Mb
2	615	4	300	17	20.4Mb
3	615	6	300	17	30.6Mb
4	940	8	512	17	62.4Mb
5	940	6	512	17	46.8Mb
6	615	4	65535	17	20.4Mb
7	462	8	256	17	30.7Mb
8	733	5	65535	17	30.4Mb
9	900	15	65535	17	112Mb
10	820	3	65535	17	20.4Mb
11	855	5	65535	17	35.5Mb
12	855	7	65535	17	49.7Mb
13	306	8	128	17	20.3Mb
14	733	7	65535	17	42.6Mb
15	0	0	0	0	Reserved
16	612	4	0	17	20.3Mb
17	977	5	300	17	40.6Mb

18	977	7	65535	17	56.8Mb
19	1024	7	512	17	59.5Mb
20	733	5	300	17	30.4Mb
21	733	7	300	17	42.6Mb
22	733	5	300	17	30.4Mb
23	306	4	0	17	10.2Mb
24	612	4	305	17	20.3Mb
25	306	4	65535	17	10.2Mb
26	612	4	65535	17	20.3Mb
27	698	7	300	17	40.6Mb
28	976	5	488	17	40.5Mb
29	306	4	0	17	10.2Mb
30	611	4	306	17	20.3Mb
31	732	7	300	17	42.5Mb
32	1023	5	65535	17	42.5Mb
33	614	4	65535	25	30.0Mb
34	775	2	65535	27	20.4Mb
35	921	2	65535	33	29.7Mb
36	402	4	65535	26	20.4Mb
37	580	6	65535	26	44.2Mb
38	845	2	65535	36	29.7Mb
39	769	3	65535	36	40.6Mb
40	531	4	65535	39	40.5Mb
41	577	2	65535	36	20.3Mb

42	654	2	65535	32	20.4Mb
43	923	5	65535	36	81.1Mb
44	531	8	65535	39	80.9Mb

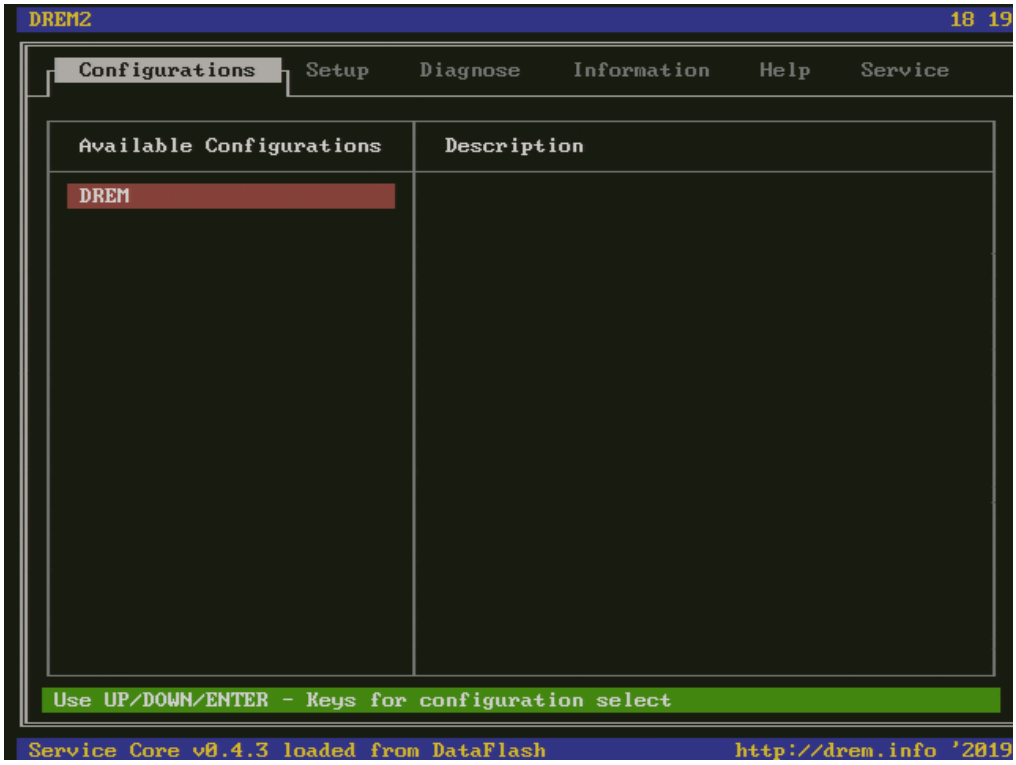
Additional information on BIOS disk types for different manufacturers may be found at http://www.win.tue.nl/~aeb/linux/hdtypes/hdtypes-3.html

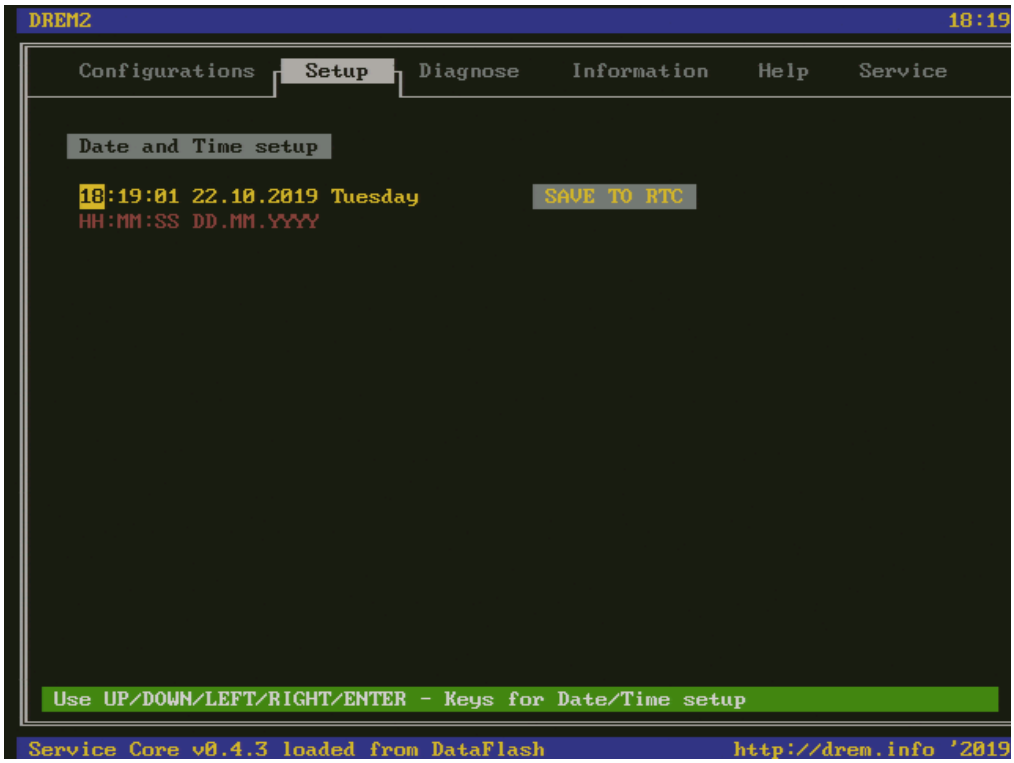
Appendix 2. PIC firmware service menu

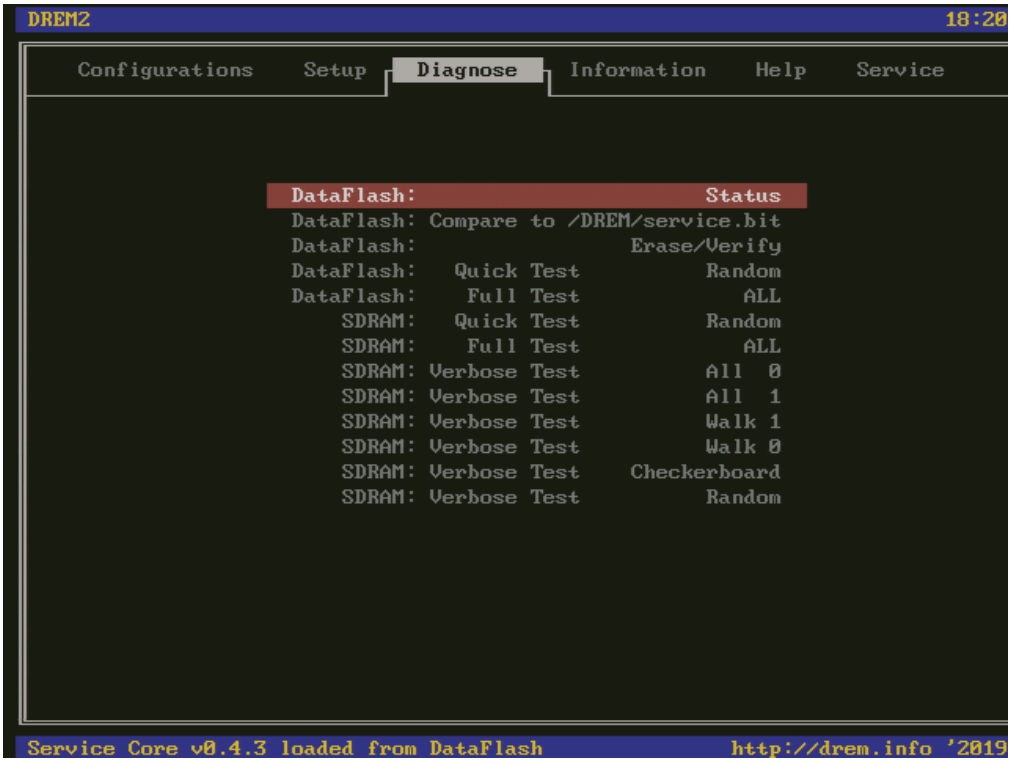
Starting DREM without an SD card enables access to the service menu. Service menu may be controlled using the PS/2 keyboard or Snapshot button.

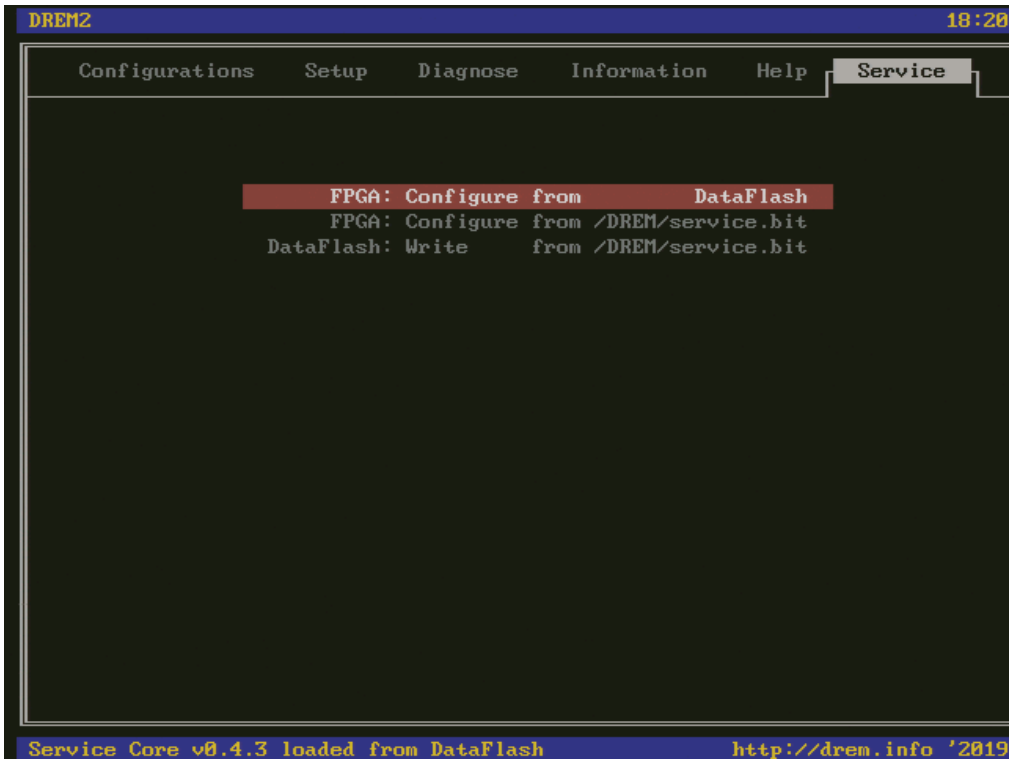
Snapshot Button Functions:

Click	Next Menu Item
Double Click	Select Menu Item
Hold	Next Tab



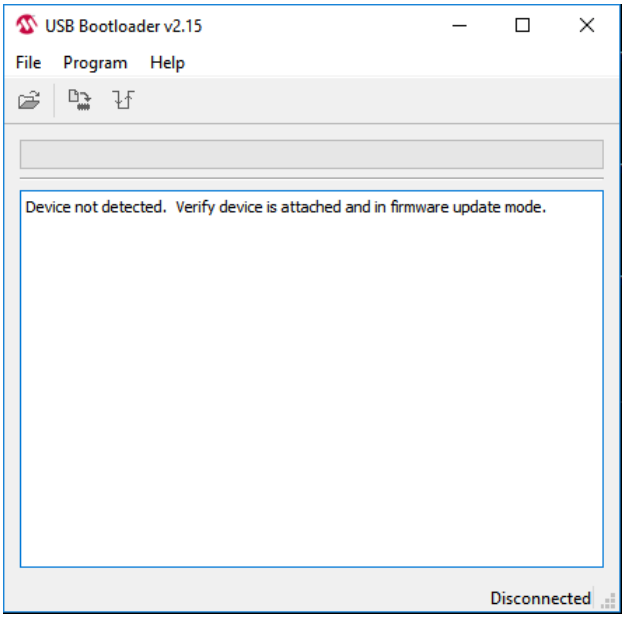




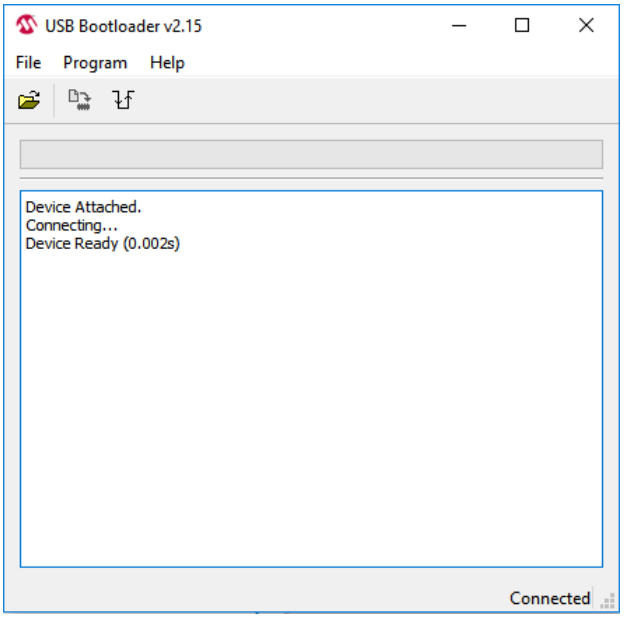


Appendix 3. PIC firmware upgrade

1. Connect DREM to a PC using micro USB cable
2. Start *HIDBootloader.exe* on PC



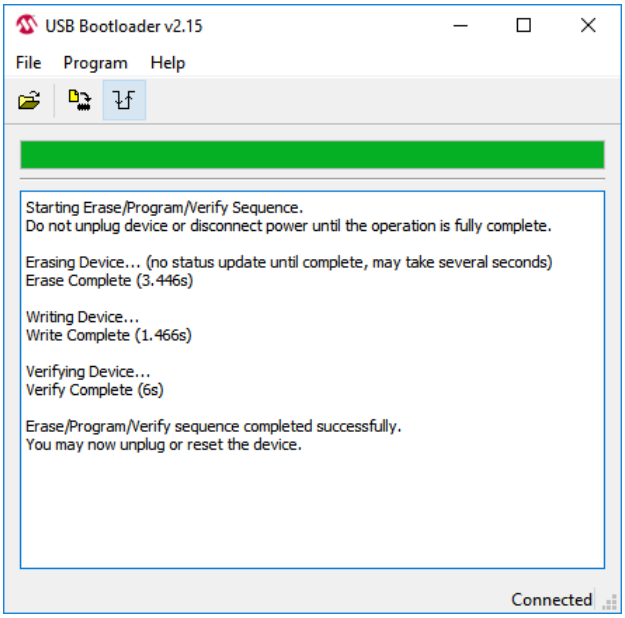
3. Power up DREM while pressing down DREM button.



4. Load firmware file by clicking  or navigating to: *File -> Import Firmware Image*

DREM PIC firmware files have names like this: **firmware_V0.4_pic24fj256gb206.hex**

5. Start DREM programming by clicking  or navigating to: *Program -> Erase/Program/Verify Device*



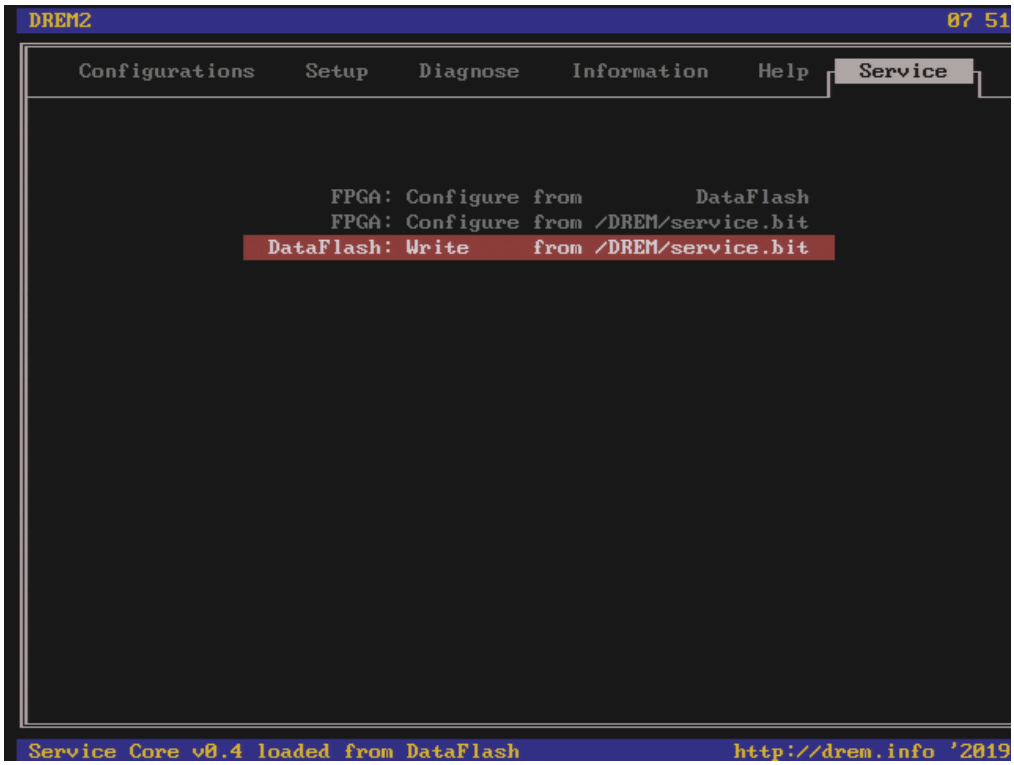
6. Power off and disconnect DREM

Appendix 4. Service Core upgrade

1. Upgrade PIC firmware to V0.4 minimum. Please **Appendix 2** for instructions.
2. Use PC to copy **service.bit** file into **/DREM** SD card directory.
3. Start DREM without SD card
4. Insert SD card
5. Press <TAB> several times to enter DREM *Service* menu, select

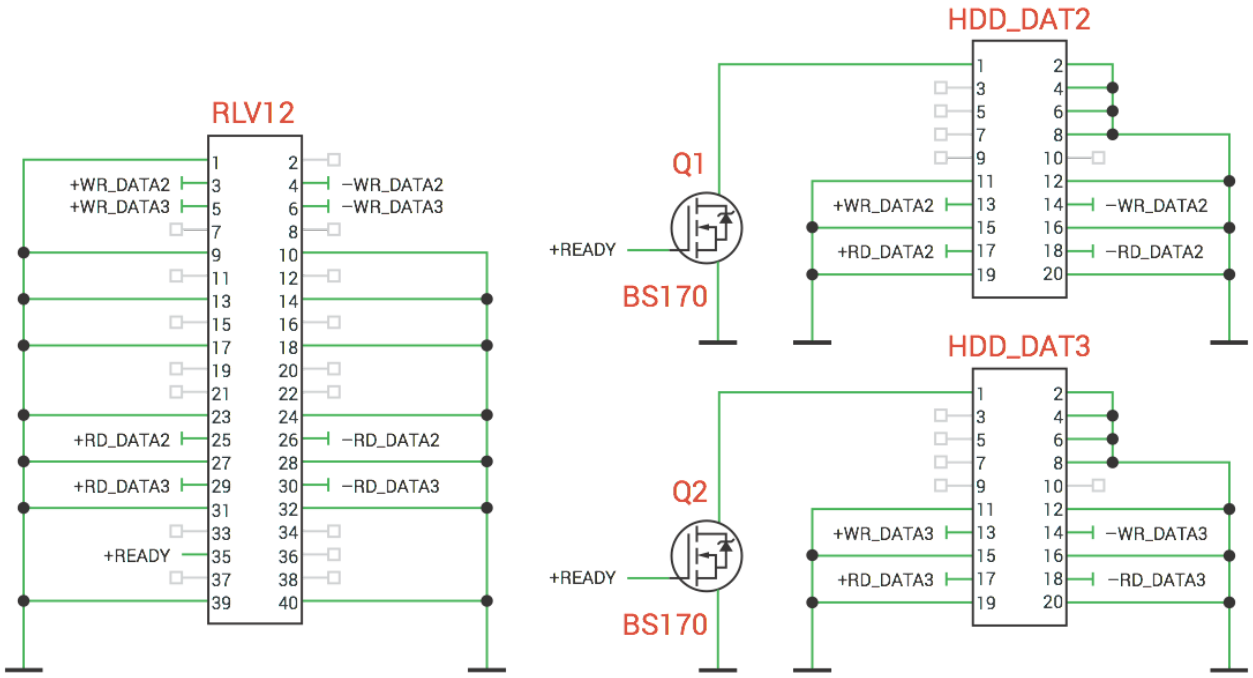
   DataFlash: Write from /DREM/service.bit

   and press <ENTER>
6. Wait until DataFlash write is completed and restart DREM



Appendix 5. ST506/ST412 four drive operation

For four drive ST506 applications, like DEC PDP RQDX3, it is possible to connect up to four MFM/RLL hard drives to DREM ST560/ST412 HDD interface. Two additional HDD Data connectors are derived from the RLV12 interface using a simple interface adapter.



PCB design CAD file is included in the software package for your convenience.

Appendix 6. Log file example

TOP: Video “Log 1 - Seagate ST11 HDD and 1.44Mb MFM Floppy on IBM PC” is posted on DREM website

IBM PC with single FDD and two HDD’s emulated using a single DREM unit.

Brief workflow description:

- MS DOS is booted from FDD A:
- C:
- copy A:fdisk.com

```
DREM-2 FDD/HDD Emulator. (c)2016-2019 PortaOne, Inc.
Software V6.9 Nov 15 2019 10:21:07 / FPGA Code V6.9
RAM Total:128 Mb, Heap: malloc():126 Mb, Static:  0 Mb

RTC: Sat 16 Nov 2019 15:10:37 Commands Available:
 H/Ctrl+H - Help Cmd/Log (Sync to SD)      Ctrl/Alt+C - Console Log YES/NO
      *,F - File Manager                   Ctrl/Alt+D - Debug WR YES/NO
      -,M - Menu Driven DSK selector       Ctrl/Alt+P - Debug Payload YES/NO
 0123ABCD - Drive Info                     Ctrl/Alt+L - Log File Open/Close
        Q - Drive Cache State              Ctrl/Alt+W - L1 Sync WRFIFO/STEP
        V - Drive Map                          Ctrl+B - PC BIOS HDD Types
        W - Cache Timing and Memory Usage      Ctrl+S - Create DSK Snapshot
   Ctrl+0 - Display Drive Change Timer      Ctrl+1..3 - Display/Reset User Timer
      <,> - Cycle LLF variables                   ^,v - Dec/Inc LLF variable


   *** SD Card Type ***
SD Ver 2 Block Addressing

   *** SD Card CID ***
Manufacturer ID........116
OEM/Application ID......"J`"
Product name............"SDC  "
Product version........1.0
Product serial number..0x05E00498
Manufacturing date.....Nov 2016

   *** SD Card Status ***
Card Type..............0x0000
Speed Class............10

   *** SD Card CSD ***
CSD Version............V2.0
TAAC,us................1000
```

```
NSAC,clk's.............0
Transfer Speed,Mbit/s..25
NSAC,us................0
Total Access Time,us...1000
Command Class..........0, 2, 4, 5, 7, 8, 10
Read Block Length......512
Size,Blocks............15759360
Size,Binary Mb.........7680
Size,Binary Gb.........7.50
Size,SI Mb.............8069
Size,SI Gb.............8.07
Permanent WR Protect...NO
Temporary WR Protect...NO
High Speed SPI Mode....Supported
Set High Speed SPI.....OK
Transfer Speed,Mbit/s..50
Total Access Time,us...1000

Loading drives configured in DREM2.INI ...

Drive 0: /DEFAULT0.DSK
Drive 1: /DEFAULT1.DSK
Drive 2: /DEFAULT2.DSK not found
Drive 3: /DEFAULT3.DSK not found
Drive A: /DEFAULTA.DSK
Drive B: /DEFAULTB.DSK not found
Drive C: /DEFAULTC.DSK not found
Drive D: /DEFAULTD.DSK not found
Drive 0: Reading CFG ... /DEFAULT0.CFG found.

===================================CFG File=====================================
[DSK]
Name=Seagate ST124 21M
Encoding=MFM
RPM=3600
Tracks=615
Sides=4
Sectors=17
First Sector ID=0
Sector Size=512
Format=ST
Interleave=1
Snapshot Enabled=1



================================================================================

Drive 1: Reading CFG ... /DEFAULT1.CFG found.

===================================CFG File=====================================
```



```
[DSK]
Name=Seagate ST124 21M
Encoding=MFM
RPM=3600
Tracks=615
Sides=4
Sectors=17
First Sector ID=0
Sector Size=512
Format=ST
Step Rate=1
Interleave=1
Snapshot Enabled=1
L1 Sync Event=WRFIFO

================================================================================

Drive A: Reading CFG ... /DEFAULTA.CFG found.

====================================CFG File====================================
[DSK]
Name=PC 3"5 1.44M
Encoding=MFM
Bitrate=500
Tracks=80
Sides=2
Sectors=18
First Sector ID=1
Sector Size=512
Format=IBM
Interface=IBM-PC
Snapshot Enabled=1
L1 Sync Event=WRFIFO


================================================================================


Allocating RAM...

Available  98240 Kb
Drive 0:   21413 Kb RAM required
Drive 1:   21413 Kb RAM required
Drive A:    1567 Kb RAM required
   Total   44393 Kb RAM required  45% of available RAM.
                                 100% cache allocation.

Drive 0: Loading DSK ... /DEFAULT0.DSK
Seagate ST124 21M 04 Sides, 0615 Tracks, 17 Sectors
Creating Fast Seek Linkmap... Done.
   162 Kb L1   cache RAM allocated. Cache depth is 4 cylinders.
```

```
    13 Kb SYNC cache RAM allocated.
   326 Kb CRC  cache RAM allocated.
 20910 Kb L2   cache RAM allocated. Cache depth is 615 cylinders.

 Drive 0:
 CFG Name "Seagate ST124 21M"
_____________INTERFACE_____________
HDD DS Bitmap      0xF  ENABLED
Mode               ST506/ST412
RWC Signal         NO
Ready Signal       DRV SEL
Step Rate (AUTO)     1 us  .../...
_____________DRIVE_____________
Write Protected    NO
RPM/Bitrate        3600/5000 KBPS
Encoding           MFM
RAW Track Size     10416
_____________DREM_____________
L1/L2 Size         4/615
L1 Sync Event      WRFIFO
Snapshot           ENABLED
Auto Snapshot      100 min
_____________FORMAT_____________
Format             ST
Encoding           MFM
TR# /Precomp.      615/NO
SD# /SEC# S:H/Size 4/17:0/512
FirstID/Interleave 0/1
Side/Track Skew    0/0
GAP4a/SYNC/GAP4    0/10/xxx(AUTO)
GAP1/GAP2/GAP3     0/0/20
GAP Byte           0x4E

CRC  ST CRC32
                   order=32 polynom=0x41044185
                   init=0x0 xor=0x0
                   direct=1 refin=0 refout=0

Drive 1: Loading DSK ... /DEFAULT1.DSK
Seagate ST124 21M 04 Sides, 0615 Tracks, 17 Sectors
Creating Fast Seek Linkmap... Done.
   162 Kb L1   cache RAM allocated. Cache depth is 4 cylinders.
    13 Kb SYNC cache RAM allocated.
   326 Kb CRC  cache RAM allocated.
 20910 Kb L2   cache RAM allocated. Cache depth is 615 cylinders.

 Drive 1:
 CFG Name "Seagate ST124 21M"
_____________INTERFACE_____________
HDD DS Bitmap      0xF  ENABLED
Mode               ST506/ST412
```

```
RWC Signal          NO
Ready Signal        DRV SEL
Step Rate             1 us  .../...
_____________DRIVE_____________
Write Protected     NO
RPM/Bitrate         3600/5000 KBPS
Encoding            MFM
RAW Track Size      10416
_____________DREM______________
L1/L2 Size          4/615
L1 Sync Event       WRFIFO
Snapshot            ENABLED
Auto Snapshot       100 min
_____________FORMAT____________
Format              ST
Encoding            MFM
TR# /Precomp.       615/NO
SD# /SEC# S:H/Size 4/17:0/512
FirstID/Interleave 0/1
Side/Track Skew     0/0
GAP4a/SYNC/GAP4     0/10/xxx(AUTO)
GAP1/GAP2/GAP3      0/0/20
GAP Byte            0x4E

CRC  ST CRC32
                    order=32 polynom=0x41044185
                    init=0x0 xor=0x0
                    direct=1 refin=0 refout=0

Drive A: Loading DS DSK ... /DEFAULTA.DSK
PC 3"5 1.44M 02 Sides, 0080 Tracks, 18 Sectors
Creating Fast Seek Linkmap... Done.
    97 Kb L1   cache RAM allocated. Cache depth is 4 cylinders.
     6 Kb SYNC cache RAM allocated.
    22 Kb CRC  cache RAM allocated.
  1440 Kb L2   cache RAM allocated. Cache depth is 80 cylinders.

 Drive A:
 CFG Name "PC 3"5 1.44M"
_____________INTERFACE_____________
FDD DS Bitmap       0xF  ENABLED
Mode                IBM-PC
Cable               STRAIGHT
Ready Signal        DISK CNG
Step Rate (AUTO)      1 us  .../...
_____________DRIVE_____________
Write Protected     NO
RPM/Bitrate         299/500 KBPS
Encoding            MFM
RAW Track Size      12500
_____________DREM______________
```

```
L1/L2 Size          4/80
L1 Sync Event       WRFIFO
Snapshot            ENABLED
Auto Snapshot       100 min
_______________FORMAT_______________
Format              IBM
Encoding            MFM
TR# /Precomp.TR     80/43
Precompensation     125 ns
SD# /SEC# S:H/Size  2/18:0/512
FirstID/Interleave  1/1
Side/Track Skew     0/0
GAP4a/SYNC/GAP4     50/12/xxx(AUTO)
GAP1/GAP2/GAP3      32/22/40
GAP Byte            0x4E
___________FORMAT SPECIFIC___________
Write Splice        NO

CRC  CRC16/CCITT-FALSE
                    order=16 polynom=0x1021
                    init=0xFFFF xor=0x0
                    direct=1 refin=0 refout=0
================================================================================
A: MFM Read  TR:00 SD:0 SD->L2->L1
A: MFM Read  TR:01 SD:0 SD->L2->L1 |> [L1] >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
A: MFM Read  TR:45 SD:0 SD->L2->L1 |> [L1] <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
A: MFM Read  TR:03 SD:0 SD->L2->L1 |> [L1]
A: MFM Read  TR:00 SD:0 L1
================================================================================
B: No disk in drive.
================================================================================
0: MFM Read  TR:0000 SD:00 SD->L2->L1 |> [L1]
0: MFM Read  TR:0001 SD:00 SD->L2->L1
0: MFM Read  TR:0002 SD:00 SD->L2->L1
0: MFM Read  TR:0001 SD:00 L1
0: MFM Read  TR:0000 SD:00 L1
================================================================================
1: MFM Read  TR:0000 SD:00 SD->L2->L1 |> [L1]
1: MFM Read  TR:0001 SD:00 SD->L2->L1
1: MFM Read  TR:0002 SD:00 SD->L2->L1
1: MFM Read  TR:0001 SD:00 L1
1: MFM Read  TR:0000 SD:00 L1
================================================================================
0: MFM Seek  TR:0000 > 0000 SD:00 > 00
0: MFM Seek  TR:0000 > 0000 SD:00 > 00
0: MFM Read  TR:0000 SD:00 L1 [B:-]
================================================================================
1: MFM Seek  TR:0000 > 0000 SD:00 > 00
================================================================================
B: No disk in drive.
================================================================================
```

```
1: MFM Read  TR:0000 SD:00 L1
================================================================================
A: MFM Seek  TR:00 > 00 SD:0 > 0
A: MFM Seek  TR:00 > 00 SD:0 > 1
A: MFM Seek  TR:00 > 00 SD:1 > 0
A: MFM Seek  TR:00 > 00 SD:0 > 1
A: MFM Seek  TR:00 > 00 SD:1 > 0
A: MFM Read  TR:01 SD:0 L1
A: MFM Seek  TR:01 > 01 SD:0 > 1
A: MFM Seek  TR:01 > 01 SD:1 > 0
A: MFM Read  TR:02 SD:0 L1-:00 SD->L2->L1 <>> X
================================================================================
0: MFM Seek  TR:0000 > 0001 SD:00 > 00
0: MFM Read  TR:0001 SD:00 L1 [A:-]
0: MFM Seek  TR:0001 > 0001 SD:00 > 01
================================================================================
A: MFM Seek  TR:02 > 02 SD:0 > 0
================================================================================
1: MFM Seek  TR:0000 > 0001 SD:00 > 00
1: MFM Seek  TR:0000 > 0001 SD:00 > 00
1: MFM Read  TR:0001 SD:00 L1
================================================================================
A: MFM Seek  TR:02 > 02 SD:0 > 0
================================================================================
1: MFM Seek  TR:0001 > 0001 SD:00 > 01
1: MFM Seek  TR:0001 > 0001 SD:00 > 01
1: MFM Seek  TR:0001 > 0000 SD:01 > 00
1: MFM Read  TR:0000 SD:01 L1 X
1: MFM Read  TR:0001 SD:01 L1
================================================================================
A: MFM Seek  TR:02 > 02 SD:0 > 0
================================================================================
0: MFM Seek  TR:0001 > 0001 SD:00 > 00
0: MFM Seek  TR:0001 > 0001 SD:00 > 00
0: MFM Read  TR:0000 SD:00 L1 X
0: MFM Read  TR:0001 SD:00 L1
================================================================================
A: MFM Seek  TR:02 > 02 SD:0 > 0
================================================================================
1: MFM Seek  TR:0001 > 0001 SD:00 > 00
1: MFM Seek  TR:0001 > 0001 SD:00 > 00
================================================================================
A: MFM Seek  TR:02 > 00 SD:0 > 0
A: MFM Read  TR:00 SD:0 L1-:02 L2->L1 >
A: MFM Read  TR:02 SD:0 L1-:00 L2->L1
A: MFM Seek  TR:02 > 02 SD:0 > 1
A: MFM Seek  TR:02 > 02 SD:1 > 0
A: MFM Read  TR:03 SD:0 L1
A: MFM Seek  TR:03 > 03 SD:0 > 1
A: MFM Seek  TR:03 > 03 SD:1 > 0 <<
A: MFM Read  TR:00 SD:0 L1-:02 L2->L1
```

```
A: MFM Seek  TR:00 > 00 SD:0 > 1 >>
A: MFM Read  TR:03 SD:0 L1
A: MFM Seek  TR:03 > 03 SD:0 > 1
A: MFM Seek  TR:03 > 03 SD:1 > 0 <<
A: MFM Read  TR:00 SD:0 L1
A: MFM Seek  TR:00 > 01 SD:0 > 1 >>
A: MFM Read  TR:03 SD:0 L1
A: MFM Seek  TR:03 > 03 SD:0 > 1
A: MFM Seek  TR:03 > 03 SD:1 > 0
A: MFM Read  TR:04 SD:0 L1-:01 SD->L2->L1 <<>>> X
A: MFM Seek  TR:04 > 04 SD:0 > 1
A: MFM Seek  TR:04 > 04 SD:1 > 0
A: MFM Read  TR:05 SD:0 L1-:04 SD->L2->L1 <<<>>>> X
IDLE / MOTOR OFF
DS T/O 5 sec.
A: MFM Seek  TR:05 > 05 SD:0 > 0
A: MFM Seek  TR:05 > 05 SD:0 > 1
A: MFM Seek  TR:05 > 05 SD:1 > 0
A: MFM Read  TR:06 SD:0 L1-:05 SD->L2->L1 <<<<>>>> X
A: MFM Seek  TR:06 > 06 SD:0 > 1
A: MFM Seek  TR:06 > 06 SD:1 > 0
A: MFM Read  TR:07 SD:0 L1-:06 SD->L2->L1 <<<<>>>>> X
A: MFM Seek  TR:07 > 07 SD:0 > 1
A: MFM Seek  TR:07 > 07 SD:1 > 0
A: MFM Read  TR:08 SD:0 L1-:07 SD->L2->L1 <<<<>>>>>> X
================================================================================
0: MFM Seek  TR:0001 > 0002 SD:00 > 00
0: MFM Read  TR:0002 SD:00 L1
0: MFM Seek  TR:0002 > 0002 SD:00 > 01 [A:--]
0: MFM Seek  TR:0002 > 0002 SD:01 > 00
0: MFM Seek  TR:0002 > 0002 SD:00 > 01
0: MFM Write TR:0002 SD:01 L1->L2 SEC: 15*
================================================================================
A: MFM Seek  TR:08 > 08 SD:0 > 0
================================================================================
0: MFM Seek  TR:0002 > 0001 SD:00 > 00
0: MFM Read  TR:0001 SD:00 L1
0: MFM Seek  TR:0001 > 0001 SD:00 > 01 [A:--]
0: MFM Seek  TR:0001 > 0001 SD:01 > 00
0: MFM Seek  TR:0001 > 0001 SD:00 > 01
================================================================================
A: MFM Seek  TR:08 > 08 SD:0 > 0
================================================================================
0: MFM Seek  TR:0001 > 0001 SD:00 > 01 [A:--]
0: MFM Seek  TR:0001 > 0001 SD:01 > 00
0: MFM Seek  TR:0001 > 0001 SD:00 > 01
================================================================================
A: MFM Seek  TR:08 > 08 SD:0 > 0
================================================================================
0: MFM Seek  TR:0001 > 0001 SD:00 > 01
================================================================================
```

```
A: MFM Seek  TR:08 > 08 SD:0 > 0
================================================================================
0: MFM Seek  TR:0001 > 0001 SD:00 > 01 [A:--]
0: MFM Seek  TR:0001 > 0001 SD:01 > 00
0: MFM Seek  TR:0001 > 0001 SD:00 > 01 [A:--]
0: MFM Seek  TR:0001 > 0001 SD:01 > 00
0: MFM Seek  TR:0001 > 0001 SD:00 > 01
================================================================================
A: MFM Seek  TR:08 > 08 SD:0 > 0
================================================================================
0: MFM Seek  TR:0001 > 0001 SD:00 > 01 [A:-]
0: MFM Read  TR:0000 SD:00 L1
0: MFM Read  TR:0001 SD:00 L1
0: MFM Read  TR:0002 SD:00 L1
0: MFM Read  TR:0001 SD:00 L1
0: MFM Read  TR:0000 SD:00 L1
================================================================================
1: MFM Seek  TR:0001 > 0000 SD:00 > 00
1: MFM Read  TR:0000 SD:00 L1
1: MFM Read  TR:0001 SD:00 L1
1: MFM Read  TR:0002 SD:00 L1
1: MFM Read  TR:0001 SD:00 L1
1: MFM Read  TR:0000 SD:00 L1
================================================================================
0: MFM Seek  TR:0000 > 0001 SD:00 > 00
0: MFM Read  TR:0001 SD:00 L1
0: MFM Seek  TR:0001 > 0001 SD:00 > 01 [A:--]
0: MFM Seek  TR:0001 > 0001 SD:01 > 00
0: MFM Seek  TR:0001 > 0001 SD:00 > 01 [A:--]
0: MFM Seek  TR:0001 > 0001 SD:01 > 00
0: MFM Seek  TR:0001 > 0001 SD:00 > 02
================================================================================
A: MFM Seek  TR:08 > 08 SD:0 > 0
================================================================================
0: MFM Seek  TR:0001 > 0001 SD:00 > 02 [A:-]
0: MFM Seek  TR:0001 > 0001 SD:00 > 02 [A:-] >>>>>>>>>>>>>>>>>
0: MFM Read  TR:0235 SD:00 SD->L2->L1
0: MFM Seek  TR:0235 > 0235 SD:00 > 01
0: MFM Write TR:0235 SD:01 L1->L2 SEC: 07* 08* 09* 10* 11* 12* 13* 14*
================================================================================
A: MFM Seek  TR:08 > 08 SD:0 > 0
A: MFM Seek  TR:08 > 08 SD:0 > 0
================================================================================
0: MFM Seek  TR:0235 > 0227 SD:00 > 00
0: MFM Read  TR:0227 SD:00 L1-:0235 SD->L2->L1 |> [L1]
      <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
      <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
      <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
0: MFM Read  TR:0000 SD:00 L1
0: MFM Read  TR:0001 SD:00 L1
0: MFM Read  TR:0002 SD:00 L1
```



```
0: MFM Read  TR:0001 SD:00 L1
0: MFM Read  TR:0000 SD:00 L1
================================================================================
1: MFM Seek  TR:0000 > 0000 SD:00 > 00
1: MFM Read  TR:0001 SD:00 L1
1: MFM Read  TR:0002 SD:00 L1
1: MFM Read  TR:0001 SD:00 L1
1: MFM Read  TR:0000 SD:00 L1
IDLE
================================================================================
0: MFM Seek  TR:0000 > 0280 SD:00 > 00
0: MFM Read  TR:0280 SD:00 L1-:0002 SD->L2->L1
0: MFM Seek  TR:0280 > 0280 SD:00 > 01
0: MFM Write TR:0280 SD:01 L1->L2 SEC: 11* 12* 13* 14* 15* 16*
0: MFM Seek  TR:0280 > 0280 SD:01 > 02
0: MFM Write TR:0280 SD:02 L1->L2 SEC: 00* 01* 02* 03* 04* 05* 06* 07* 08* 09* 10*
      11* 12* 13* 14* 15* 16*
0: MFM Seek  TR:0280 > 0280 SD:02 > 03
0: MFM Write TR:0280 SD:03 L1->L2 SEC: 00* 01* 02* 03* 04* 05* 06* 07* 08* 09* 10*
      11* 12* 13* 14* 15* 16*
0: MFM Read  TR:0281 SD:03 L1-:0280 SD->L2->L1
0: MFM Seek  TR:0281 > 0281 SD:03 > 00
0: MFM Write TR:0281 SD:00 L1->L2 SEC: 00* 01* 02* 03* 04* 05* 06* 07* 08* 09* 10*
      11* 12* 13* 14* 15* 16*
0: MFM Seek  TR:0281 > 0281 SD:00 > 01
0: MFM Write TR:0281 SD:01 L1->L2 SEC: 00* 01* 02* 03* 04* 05* 06* 07* 08* 09* 10*
      11* 12* 13* 14* 15* 16*
0: MFM Seek  TR:0281 > 0281 SD:01 > 02
0: MFM Write TR:0281 SD:02 L1->L2 SEC: 00* 01* 02* 03* 04* 05* 06* 07* 08* 09* 10*
      11* 12* 13* 14* 15* 16*
0: MFM Seek  TR:0281 > 0281 SD:02 > 03
0: MFM Write TR:0281 SD:03 L1->L2 SEC: 00* 01* 02* 03* 04* 05* 06* 07*
IDLE
0: MFM Seek  TR:0281 > 0251 SD:03 > 00 <<<<<<<<<<<<<<<
0: MFM Read  TR:0002 SD:00 L1-:0281 L2->L1
0: MFM Seek  TR:0002 > 0002 SD:00 > 01
IDLE
0: MFM Seek  TR:0002 > 0001 SD:01 > 00
0: MFM Read  TR:0001 SD:00 L1
0: MFM Seek  TR:0001 > 0001 SD:00 > 01
0: MFM Write TR:0001 SD:01 L1->L2 SEC: 01
0: MFM Seek  TR:0001 > 0001 SD:01 > 03
0: MFM Write TR:0001 SD:03 L1->L2 SEC: 08
0: MFM Seek  TR:0001 > 0001 SD:03 > 01
0: MFM Write TR:0001 SD:01 L1->L2 SEC: 16*
0: MFM Read  TR:0002 SD:00 L1
0: MFM Write TR:0002 SD:00 L1->L2 SEC: 06*
0: MFM Read  TR:0001 SD:00 L1
0: MFM Seek  TR:0001 > 0001 SD:00 > 02
0: MFM Write TR:0001 SD:02 L1->L2 SEC: 02*
0: MFM Read  TR:0002 SD:00 L1
```

```
0: MFM Write TR:0002 SD:00 L1->L2 SEC: 09*
0: MFM Read  TR:0281 SD:00 L1-:0002 L2->L1
0: MFM Seek  TR:0281 > 0281 SD:00 > 03
0: MFM Write TR:0281 SD:03 L1->L2 SEC: 08* <<<<<<<<<<<<<<<<<<<
0: MFM Read  TR:0002 SD:00 L1-:0281 L2->L1
0: MFM Seek  TR:0002 > 0002 SD:00 > 01
0: MFM Write TR:0002 SD:01 L1->L2 SEC: 15*
================================================================================
A: MFM Seek  TR:08 > 08 SD:0 > 0
A: MFM Seek  TR:08 > 07 SD:0 > 1 <<<<<
A: MFM Read  TR:00 SD:0 L1
A: MFM Seek  TR:00 > 00 SD:0 > 1
A: MFM Seek  TR:00 > 00 SD:1 > 0
IDLE / MOTOR OFF
DS T/O 5 sec.
================================================================================
0: MFM Sync  L2->SD TR:ALL    0001 0002 0235 0280 0281
```

Appendix 7. Gathering log for unknown LLF

If your controller is not supported yet or you are having trouble identifying the correct LLF configuration - we are here to help! Please collect debug information as described below and email it to info@drem.info

1. Use any pair of **CFG**+**DSK** files provided with DREM. For instance copy

   \WDC\WDXT-GEN2 WDX3 MFM\default0.cfg

   and

   \WDC\WDXT-GEN2 WDX3 MFM\default0.dsk

   to the SD card root directory.

2. Set in DREM2.INI

```
[start-up]
start log                    = YES

[log]
console                      = YES

[cache]
l2 preload                   = NO

[debug]
disk write events            = YES
write errors only            = NO
write payload                = YES
drive                        = ALL
track                        = 0
write event occurrence       = ALL
```

3. Execute low level format (LLF) on the host computer.
4. Depending on computer type, LLF may fail after track 0 or continue execution - no need to wait for LLF for all tracks. Interrupt LLF after track 0 debug information appears on DREM screen.
5. Press **L** on the DREM keyboard in order to close the log file.
6. Repeat steps 2 - 5 for tracks 1, 256, 512 each time changing track setting in DREM2.INI

```
[debug]
track                        = 0
```

7. Send resulting log files to info@drem.info Please include your host computer type and HDD controller manufacturer name and model number. Also, please include pictures of your HDD controller with visible and readable IC designations.

Log Example

Below in an example of Debug WR log output you may expect during LLF. Please note error messages at the end - please ignore, this is normal.

```
================================================================================
0: MFM Seek  TR:0000 > 0000 SD:00 > 00 WR
0: MFM Seek  TR:0000 > 0000 SD:00 > 01 WR
0: MFM Write TR:0000 SD/SEC:
FIFO Address:4 -> 10419 Length:10416 Head:0 Empty Flag:0 / Sync#:0 Address:52
Data:
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E00000000
      00000000000000000000A1*(04-0)FE002000AAC8000000000000000000000000000000A1*(0
      4-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000000000000000A1*(
      04-0)FE002001BAE9000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
```


4E4E4E4E4E4E4E4E4E4E0000000000000000000000000000A1*(04-0)FE0020028A8A0000000
00000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A
340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000
000000000000000000000000A1*(04-0)FE0020039AAB000000000000000000000000000000A
1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000000000000000
A1*(04-0)FE002004EA4C000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000000000000000A1*(04-0)FE002005FA6D000
000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF


```
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1D
FF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
000000000000000000000000000000A1*(04-0)FE002006CA0E00000000000000000000000000000
000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000000000
0000A1*(04-0)FE002007DA2F000000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E00000000000000000000000000000000A1*(04-0)FE0020082BC
00000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
```

FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E0000000000000000000000000000A1*(04-0)FE0020093BE100000000000000000000000
0000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E00000000000000000000
00000000A1*(04-0)FE00200A0B82000000000000000000000000000000A1*(04-0)F8FFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000000000000000A1*(04-0)FE00200
B1BA3000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF

```
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E000000000000000000000000000000A1*(04-0)FE00200C6B44000000000000000000000
00000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000
00000000000000A1*(04-0)FE00200D7B6500000000000000000000000000000000A1*(04-0)F8FF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E000000000000000000000000000000A1*(04-0)FE0
0200E4B0600000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
```


4E4E4E4E4E4E000000000000000000000000000A1*(04-0)FE00200F5B270000000000000000
000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A34000000
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E000000000000
000000000000000A1*(04-0)FE002010B8F90000000000000000000000000000000A1*(04-0)
F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E0467060F

FIFO Address:3 -> 10419 Length:10417 Head:1 Empty Flag:0 / Sync#:0 Address:51
Data:

4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E00000000
00000000000000000000A1*(04-0)FE00210099F9000000000000000000000000000000A1*(0
4-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF

FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E000000000000000000000000000000A1*(
04-0)FE00210189D80000000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E00000000000000000000000000000000A1*(04-0)FE002102B9BB0000000
000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A
340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000
000000000000000000000000A1*(04-0)FE002103A99A0000000000000000000000000000000000A
1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF


```
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000000000000000
A1*(04-0)FE002104D97D000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000000000000000A1*(04-0)FE002105C95C000
000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1D
FF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
0000000000000000000000000000A1*(04-0)FE002106F93F000000000000000000000000000
000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
```

FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E000000000000000000000000
0000A1*(04-0)FE002107E91E000000000000000000000000000000A1*(04-0)F8FFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000000000000000A1*(04-0)FE00210818F
1000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E0000000000000000000000000000A1*(04-0)FE00210908D000000000000000000000000
0000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E00000000000000000000
00000000A1*(04-0)FE00210A38B3000000000000000000000000000000A1*(04-0)F8FFFFFF

```
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000000000000000A1*(04-0)FE00210
B28920000000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E0000000000000000000000000000A1*(04-0)FE00210C587500000000000000000000000
00000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E0000000000000000
000000000000A1*(04-0)FE00210D48540000000000000000000000000000000000A1*(04-0)F8FF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
```

```
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E000000000000000000000000000000A1*(04-0)FE0
0210E7837000000000000000000000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
4E4E4E4E4E4E000000000000000000000000000000A1*(04-0)FE00210F681600000000000000000
0000000000000000A1*(04-0)F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A34000000
4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E000000000000
000000000000000000A1*(04-0)FE0021108BC800000000000000000000000000000000A1*(04-0)
F8FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
```



```
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
      FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF1DFF3A340000004E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E4E
      4E4E4E4E4E4E000901

00/FMT-> ERROR: ID AM TR:32 ERROR: ID AM TR:32 ERROR: ID AM TR:32 ERROR: ID AM
      TR:32 ERROR: ID AM TR:32 ERROR: ID AM TR:32 ERROR: ID AM TR:32 ERROR: ID AM
      TR:32 ERROR: ID AM TR:32 ERROR: ID AM TR:32 ERROR: ID AM TR:32 ERROR: ID AM
      TR:32 ERROR: ID AM TR:32 ERROR: ID AM TR:32 ERROR: ID AM TR:32 ERROR: ID AM
      TR:32 ERROR: ID AM TR:32
01/FMT-> ERROR: ID AM TR:33 ERROR: ID AM TR:33 ERROR: ID AM TR:33 ERROR: ID AM
      TR:33 ERROR: ID AM TR:33 ERROR: ID AM TR:33 ERROR: ID AM TR:33 ERROR: ID AM
      TR:33 ERROR: ID AM TR:33 ERROR: ID AM TR:33 ERROR: ID AM TR:33 ERROR: ID AM
      TR:33 ERROR: ID AM TR:33 ERROR: ID AM TR:33 ERROR: ID AM TR:33 ERROR: ID AM
      TR:33 ERROR: ID AM TR:33
0: MFM Read  TR:0001 SD:00 SD->L2->L1
IDLE Timer #0: 0 min 05 sec
```

Appendix 8. List of controllers and systems used for testing.

PC ISA HDD Controllers

Manufacturer	Model	Bus Width, bit	Chipset	HDD	FDD	BIOS Type	DREM HDD+FDD
Adaptec	ACB-2010A	8	AIC-010	MFM		0	Y
	ACB-2070A	8	AIC-010F	RLL		0	
	ACB-2372B	16	AIC-610L	RLL	Y	1/1	
Amstrad	MC0061C[4]	8	Amstrad 8836HX	RLL		0	Y
Data Technology Corp.(DTC)	DTC-7180	16	DTC-076B-1	MFM		#	Y[1]
	DTC-5160X[2]	8	DTC-076 C-3	RLL		0	Y
N/A (Distributed by DMC)	N/A (WD1003-WA2 Compatible)	16	WD2010B	MFM	Y	#	
Everex	EV-346	16	CL-SH260-15PC-D	MFM	Y	#	
HFC	P/N 911-0016	16	CL-SH260-15PC-C	MFM	Y	#	Y
IBM	IBM-1501492[2]	8	Xebec 3198-045	MFM		0	
	IBM 5170 Gen. 1	16	WD1010A	MFM	Y	#	
Longsine	LCS-6620TX	16	HDC9234	MFM	Y	#	
National Computer Ltd.(NCL)	NDC-5027[2]	8	NCL NDC-84x	MFM		0[3]	Y
Perstor Systems Inc.	ADRC9008	8	ADRC2000	RRL		0	Y
Seagate	ST-11M	8	HA9011	MFM		0	Y

	ST-11R[2]	8	AIC-010FL	RLL		0	Y
	ST-21R/22R[2]	16	AIC-010FL	RLL	Y	0	Y
Scientific Micro Systems (SMS)	OMTI 5510-3[2]	8	SMS OMTI 20508	MFM		0	
USSR	ЕС1851.Е015[2]	8	КМ1582ВЖ2-0095 (Xebec 3198-045)	MFM		0	Y
Western Digital	WD1003-WAH	16	WD2010B	MFM		#	Y
	WD1003-WA2	16	WD2010B	MFM	Y	#	
	WD1006S-WAH	16	WD12C00A-JU	MFM		#	Y
	WDXT-GEN2	8	WD2010B	MFM		0	Y
	WX3	8	WD2010B	MFM		0	Y
	WA-6VM	16	WD42C22A-JU	MFM	Y	#	
	WD1002A-27X	8	WD5011JM	RLL		0	

[1] Jumper W6 must be CLOSED !

[2] Not compatible with Volcov Commander

[3] On board disk geometry selector DIP switch

[4] WDC compatible, BIOS LLF routine C800:5, disk geometry is set using LK5 and LK6 jumpers

Tracks/Heads	LK5	LK6
782/2	Closed	Closed
204/6	Closed	Open
782/4	Open	Closed
614/4	Open	Open

DEC QBUS Controllers

DEC M7555 RQDX3 + DEC M9058-A1 Expander RD/RX Board

DEC M8061 RLV12

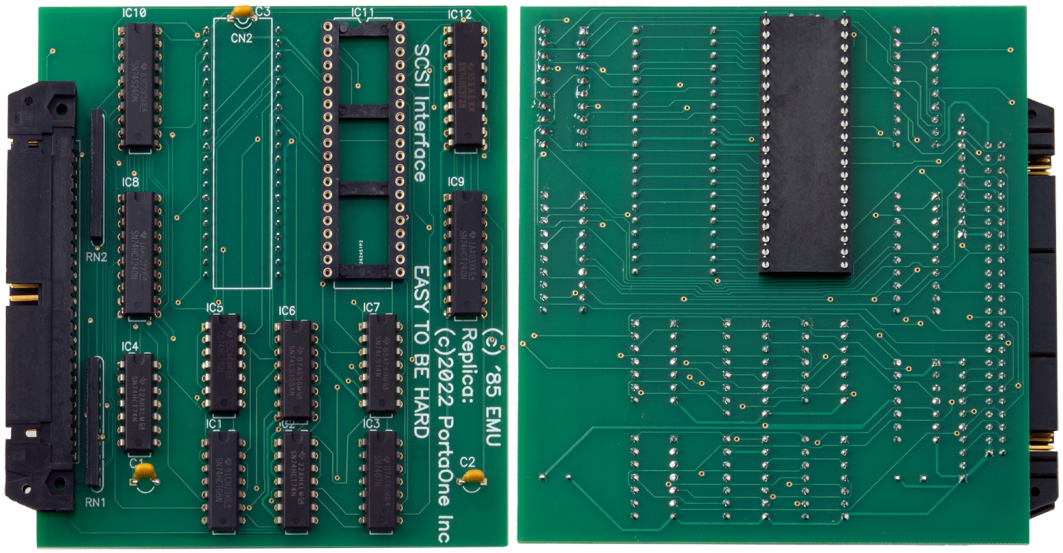
Meiden BD05 (PDP RLV12-ST506 Bridge)

Data Systems Design DSD4140 (RX01/RX02 Compatible for Shugart Drives)

Appendix 9. E-Mu Emulator II to Emulator II+HD DREM SSD upgrade.

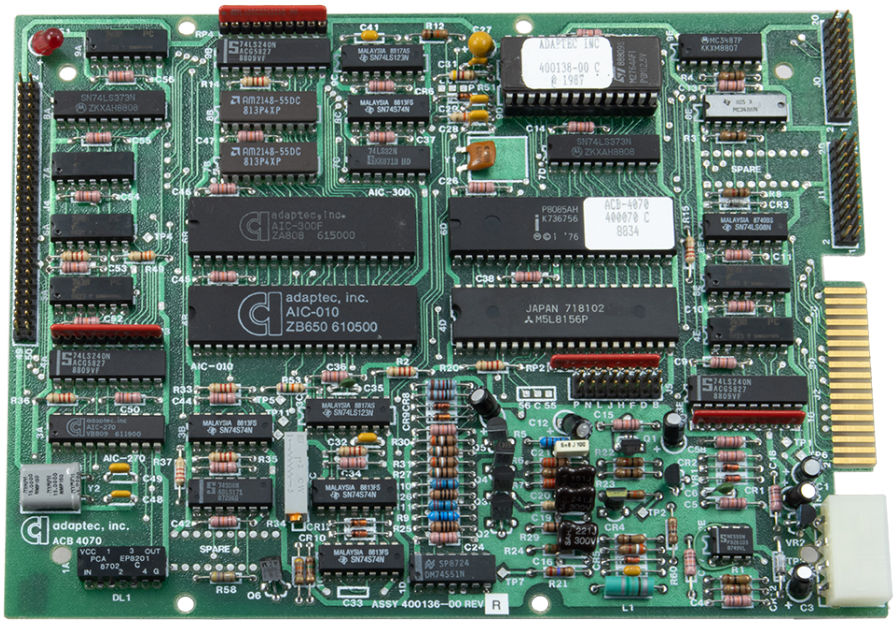
Items required:

1. DREM-3 + 5”25 bracket
2. E-Mu "Easy to be hard" board replica by PortaOne, Inc.



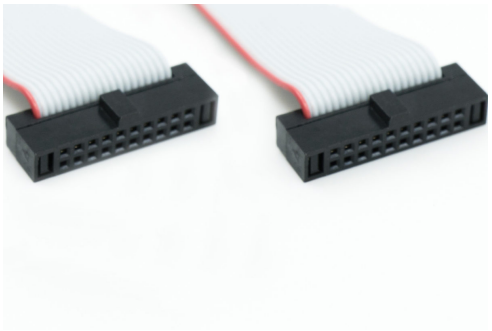
3. 2764A EPROM burned with "main_2.5v_HD_2764_ic42.bin" code (supplied with "Easy to be hard" board replica by PortaOne, Inc)

4. Adaptec ACB4000 SCSI to MFM bridge controller (or compatible i.e. ACB4010, ACB4000A)

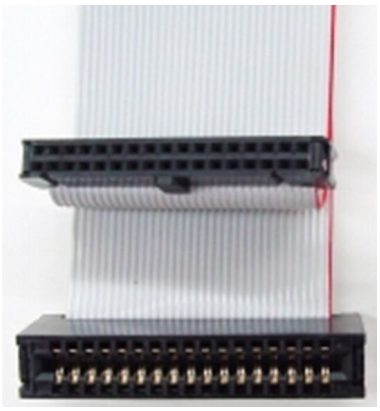


5. 50 cm long 50 wire IDC 25x2 Female-Female flat SCSI cable

6. 90 cm long 20 wire IDC 10x2 Female-Female flat MFM data cable

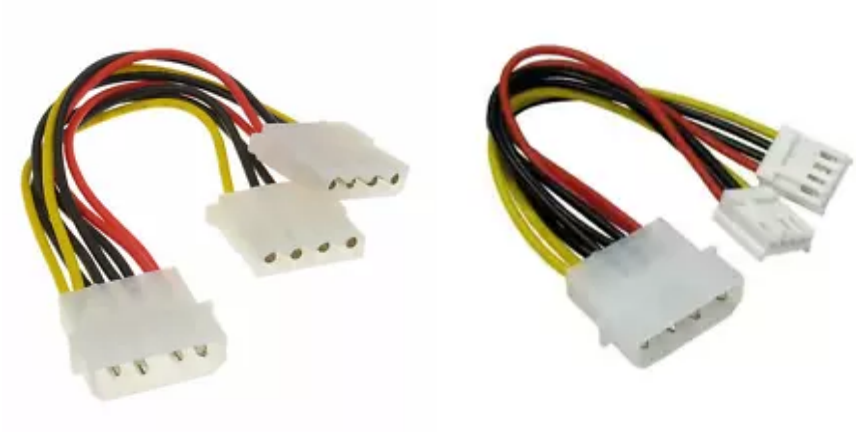


7. 90 cm long 34 wire IDC 17x2 Female-IDC 17x2 Edge flat MFM control cable



8. Molex Power Extension Cable 4pin Male 5"25/Female 5"25 36"/3ft/90cm

9. Molex Power Y Adaptor Splitter Cable 4pin Male 5"25/2 xFemale 5”25 or Male 5"25/2 xFemale 3”5. DREM power may be connected using 5”25 either 3”5 Molex connector. Please choose the cable depending on the type of FDD or FDD emulator you wish to use.

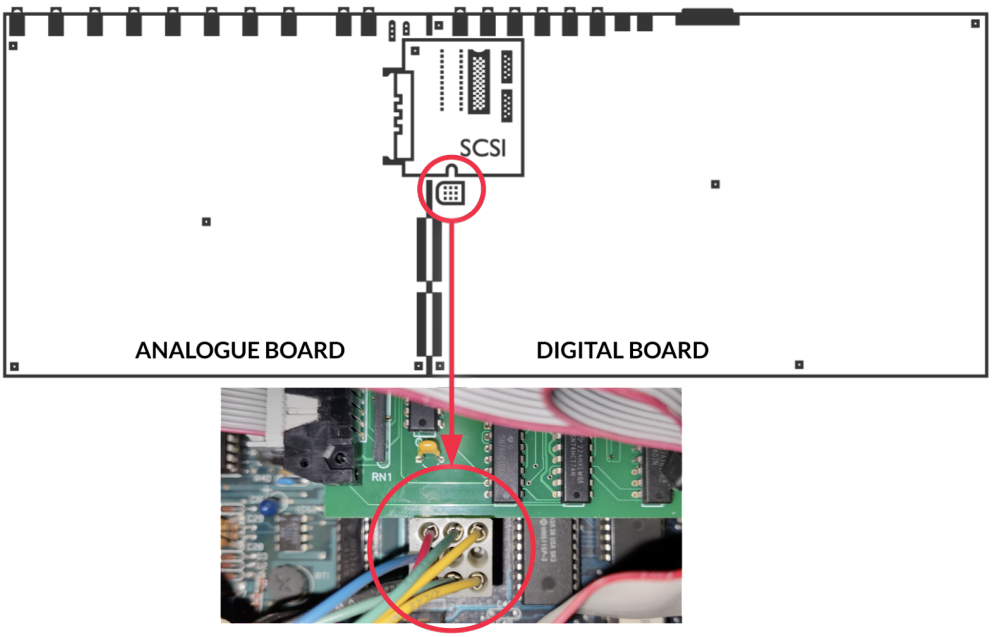


For detailed description please see E-mu Systems, Inc. publication P/N BS362 Revision C Emulator II to Emulator II+ HD Conversion.

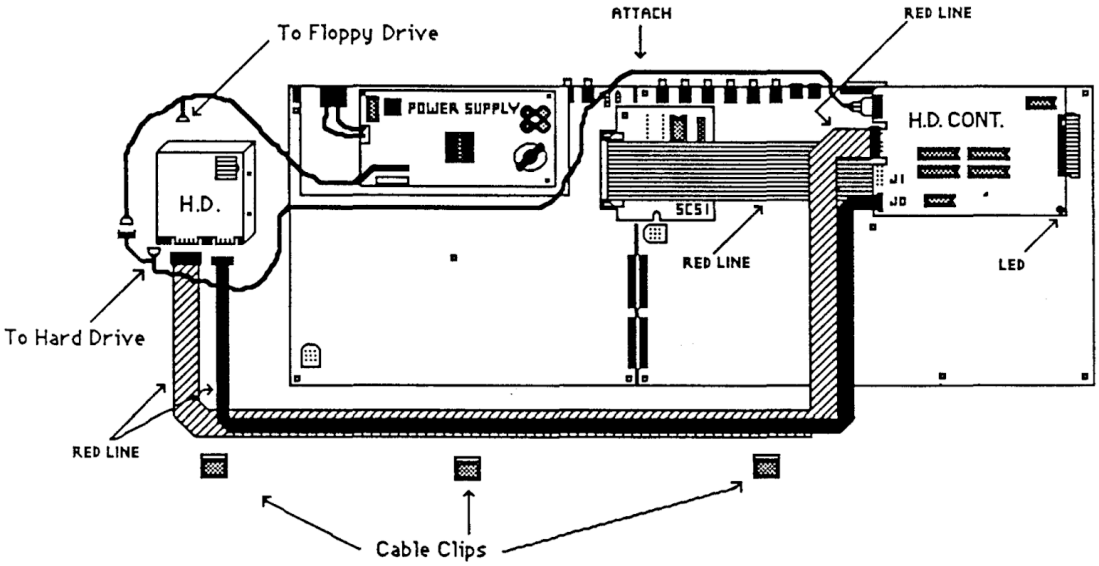
Extremely short upgrade instructions:

1. Open E-Mu Emulator II
2. Locate E-Mu Emulator Digital Board IC42 EPROM, remove existing EPROM and replace with the new one
3. Locate E-Mu Emulator Digital Board IC128 Z-80 SIO, remove existing Z-80 SIO and insert it into
4. E-Mu "Easy to be hard" board IC11 position
5. Insert E-Mu "Easy to be hard" board into E-Mu Emulator Digital Board IC128 position.

6. Pay attention to the pin alignment, use the power connector on E-Mu Emulator Digital Board as a guide for E-Mu "Easy to be hard" board: E-Mu "Easy to be hard" board must be touching the power connector.



7. Connect E-Mu "Easy to be hard" board to the Adaptec ACB4000 SCSI to MFM bridge controller using 50 cm long 50 wire IDC 25x2 Female-Female flat SCSI cable
8. Connect Adaptec ACB4000 SCSI to MFM bridge controller to DREM-3 using 90 cm long 20 wire IDC 10x2 Female-Female flat MFM data cable and 90 cm long 34 wire IDC 17x2 Female-IDC 17x2 Edge flat MFM control cable



9. Use Molex Y splitter to connect power to DREM-3 and FDD or FDD Emulator.
10. Use Molex extension cable to connect power to Adaptec ACB4000 SCSI to MFM bridge controller.