



uDW
DRIVEWIRE MICROSERVER



OWNER'S MANUAL

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DriveWire and the uDW

DriveWire is a protocol for transmitting data between a Dragon (or Tandy CoCo) and an external computer. The external computer can act as a file server (virtual floppy or disk station). Also other services are defined in the protocol, such as time/date requests and multiple virtual serial connections.

The uDW DriveWire microserver replaces the external computer, and instead provides the Dragon 32 / 64 or Tano Dragon with its own, flexible mass-storage device, storing the data on a standard micro-SD card. Also a real-time clock (RTC) is included, for timestamping of files as well as handling DriveWire time requests.

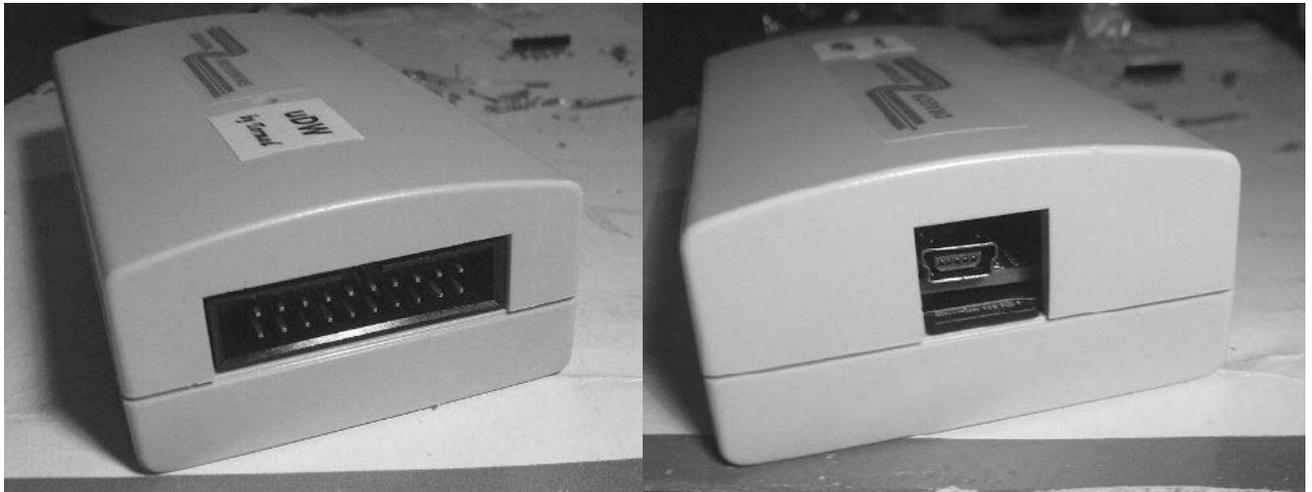
From the viewpoint of the Dragon there is no difference whether it is connected to the uDW or to a traditional DriveWire server on an external computer. The same DriveWire software can be used, whether it is HDB-DOS, NitROS-9 or DWLOAD.

The uDW microserver firmware can be conveniently upgraded over USB, and new functionality will be available through future firmware updates. The firmware is open-source and can be freely modified by the advanced experimenter.

Hardware overview

The uDW has a 20-pin female IDC connector that connects to the Dragon parallel printer port through the included flat ribbon cable.

On the other end of the uDW are the micro-SD card slot and a micro-USB connector for firmware upgrades.



On the top, a multicolour LED indicates power, activity and error conditions.

SD card compatibility

Most common SD and SDHC cards up to 32GB should be compatible. The uDW has been tested with Sandisk 2GB SD and Kingston 8GB and 32GB SDHC cards (micro-SD format).

Inserting or removing the SD card

The micro-SD card slot is of the push-push type. The card must be gently pushed in until it clicks into position. To remove it, push it further in until it releases and partially ejects. Never pull the card without pushing it in to release it first.



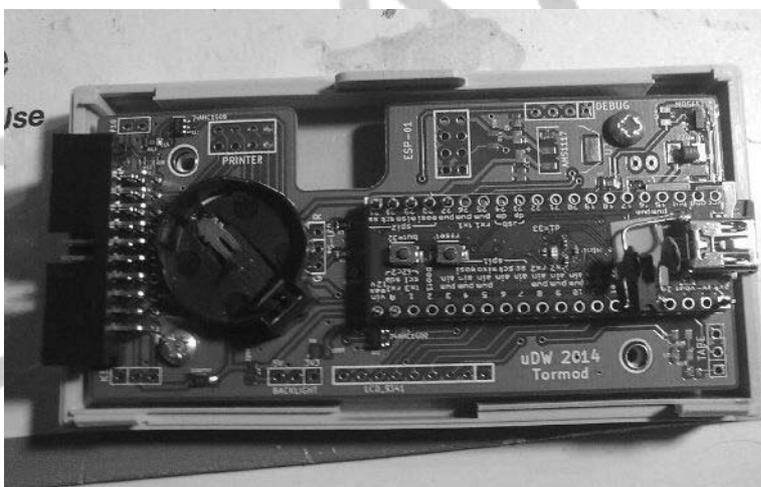
Micro-SD card partially ejected. When properly inserted, it is flush with the opening in the enclosure.

Inserting the battery for the real-time clock (RTC)

The uDW RTC uses a standard CR2032 battery (3V) to keep its clock running while the uDW is disconnected or the Dragon is turned off.

The battery is not included, and must be inserted by the user. Without the battery, the clock and date on the uDW will be reset at every power-on. File timestamps on the SD card will be wrong, but the uDW will otherwise perform as normal.

The battery must be inserted with the positive polarity side (marked “+”) facing up. Push the battery down into the holder until it clicks into position.



Connecting the uDW to the Dragon

Plug the included 20-pin IDC cable into the uDW. Plug the other end into the Dragon printer port. It is generally recommended that the Dragon is powered off while plugging/unplugging external devices. The uDW is fully powered by the Dragon, and is ready to use as soon as the Dragon is powered on. It starts up faster than the Dragon, so power-on requests from the Dragon, i.e. loading of AUTOLOAD.DWL by a DWLOAD-enabled ROM, can be serviced.

The IDC cable connectors have a notch that makes it impossible to insert them the wrong way. Note however that the cable is not symmetric so depending on which end goes into the adapter, the cable will bend upwards or downwards out from the uDW or the Dragon parallel port.



File storage on the SD card

The uDW reads normal FAT32 formatted SD cards. The current firmware only supports short filenames (8+3 characters).

Files called “DRIVEx” where x is a number between 0 and 7 are reserved for disk images and will be automatically mounted as “fixed” drives 0-7 if they exist. Typically “DRIVE0” will be the boot device for NitrOS-9.

Software on the Dragon

There is a growing list of Dragon software supporting the DriveWire protocol. Currently the most common ones are:

- HDB-DOS – a DOS originally written for the Tandy CoCo and ported to the Dragon. It is similar to but not compatible with Dragon DOS by Dragon Data Ltd.
- NitrOS-9 – an open-source, multitasking operating system compatible with OS-9 from Microware.
- DWLOAD – a minimal, DOS-less client program for reading files from the DriveWire server. Extended with on-disk “dweebs”, DLOAD can also write files and much more.

The below instructions are provided as a quick examples on how to get started and not an exhaustive documentation on using DriveWire. Please consult the respective software documentation for more information.

1. Using DWLOAD

DWLOAD can reside in a patched BASIC ROM. In this case, simply power on the Dragon and load and run files from the uDW server using:

```
DLOAD"FILENAME"
```

To only load a file without running it, append N to the DLOAD command:

```
DLOADN"FILENAME"
```

2. Using HDB-DOS

HDB-DOS can reside in a ROM cartridge. In this case just power on the Dragon and use HDB-DOS disk commands to access files on disk images DRIVE0 to DRIVE3. For instance:

```
LOAD"FILENAME"
```

3. Using NitrOS-9

NitrOS-9 is usually loaded into RAM via normal BASIC, HDB-DOS or Dragon DOS. In both cases, rename the NitrOS-9 boot disk to “DRIVE0” on the uDW SD card.

To boot from BASIC, use the DWDOS program, for example loaded from tape:

```
CLOADM"DWDOS":EXEC
```

To boot from HDB-DOS, use the HDB-DOS “DOS” command:

```
DOS
```

If you have the DWLOAD ROM, use the “DOS” dweeb:

```
DLOAD"DOS"
```

On Dragon DOS, the equivalent command is called “BOOT”. Note however that Dragon DOS reads the boot file from sectors 3-18 of track 0 while HDB-DOS reads it from track 34 (LSN 612), so the boot disks must be of the according format.

uDW commands

Some special commands can be sent to the uDW using “magic” file names. These filenames always start with a “!” (bang).

- !INFO - list information about hardware and firmware
- !LS - list the files on the SD card
- !DRIVE - list or mount drives
- !TIME - set the clock time in format HH:MM:SS
- !DATE - set the clock date in format YYYY-MM-DD

`!DFU` - switch the uDW into firmware upgrade mode

Example:

```
DLOAD"!INFO"
```

The “!`LS`” command can optionally take a folder name as argument, e.g.

```
DLOAD"!LS MYFOLDER"
```

The “!`DRIVE`” command lists all drives if no argument is given. To mount a file in drive, specify drive number 0-7 and the file name, for example:

```
DLOAD"!DRIVE 0 HDBDOS.IMG"
```

The “!`TIME`”, “!`DATE`”, and “!`DFU`” commands will return a MO (mount) error. This is normal and does not mean the command failed.

Note that these “magic” filenames are DriveWire *named objects*, and thus work with the DWLOAD client. They do not work with the LOAD command in HDBDOS or from NitrOS-9, which operates on mounted disk images, and do not refer directly to files on the SD card.

If you do not have DWLOAD in ROM, you can load a DWLOAD client in RAM. For example, if your HDBDOS image contains the DWLOAD.BIN program, loading at \$0E00:

```
LOAD"DWLOAD.BIN"  
EXEC&H0E00"!INFO"
```

A client for NitrOS-9 does currently not exist. Firmware support for the NitrOS-9 “dw” command is planned.

More commands may be added in future firmware upgrades.

Upgrading the firmware

Firmware upgrade mode can be initiated by the command “!`DFU`”. While keeping it connected to the Dragon, connect the uDW to a computer via the micro-USB socket above the SD card slot. In DFU mode the uDW LED is flashing red.

The uDW will also enter device firmware upgrade (DFU) mode if it is powered on connected over USB (Dragon disconnected or powered down). In this case it stays in DFU mode only 10 seconds before resuming normal operation mode.

The firmware upgrade is performed via the standard DFU USB protocol. The dfu-util software utility can be used to download a firmware file to the uDW. Please get the latest version of dfu-util from your package manager (Linux), Homebrew (MacOSX) or the dfu-util home page at <http://dfu-util.gnumonks.org> (Windows). The uDW can be updated with the following dfu-util command line:

```
dfu-util -R -a 1 -D udw-xxx
```

where *udw-xxx* is the name of the firmware file. If you have other DFU-capable devices connected to your computer, use the -d option to specify the uDW by its USB ID:

Installing firmware upgrade drivers on Microsoft Windows

For using dfu-util, Windows drivers for the libusb library must be set up for the uDW. Please consult the instructions on the dfu-util web site and <http://libusb.info>. After the uDW has been switched to DFU mode using the “!DFU” command, Windows will detect it as “uDW in DFU mode” and look for a driver. Run Zadig to associate uDW with the WinUSB driver. Afterwards the dfu-util command can be used as in the example above.

Tandy CoCo compatibility

The bit-banger port on the Tandy CoCo generates voltage levels compatible with most RS-232 ports, using +5/-5V. The current uDW hardware does not support the negative voltage range. Future revisions might add CoCo support.

The data transfer is serial and the serial interface is implemented through a software bit-banger both on the Dragon and the Tandy CoCo. The uDW DriveWire microserver use signalling pins on the parallel printer port which correspond exactly to the internal PIA ports used by the built-in serial port on the Tandy CoCo. Low-level software drivers are therefore fully compatible.

Hardware internals

The uDW uses a NC7SZ00 (similar to 74AHC1G00) NAND gate to buffer and invert the RX signal from the Dragon. The TX signal from the uDW passes through an AND gate. The AND gate is powered by the Dragon 5V supply, so the output is not active if the Dragon is turned off and the uDW is powered over USB. These hardware buffers add a layer of protection for both the Dragon and the uDW's micro-controller.

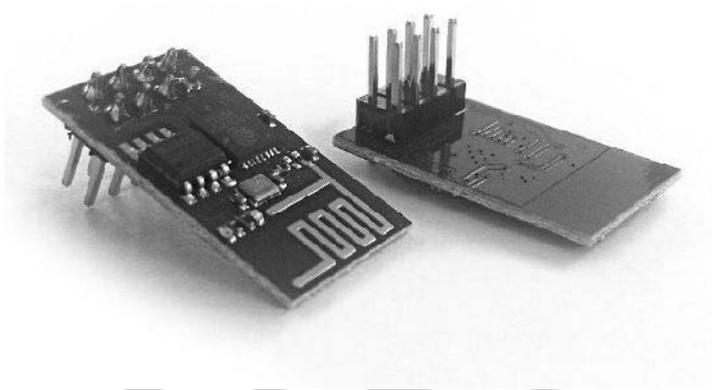
Hardware extensions

The uDW circuit board has a number of connectors and pads for the DIY hardware hacker. There are break-out pads for all pins of the parallel printer port. Some spare signals from the micro-controller are available. One serial interface is used for debugging and reprogramming the DFU boot loader, but can also be used for other purposes. One PWM (pulse-width modulation) output is brought out to a header, suitable for connecting to the analog tape input of the Dragon. This can for example be used for sound generation.

Adding a wifi module (experimental)

An ESP-01 wifi module can be soldered onto the uDW board. The board features a dedicated voltage controller for the wifi module, and allows the uDW to control the power mode of the module. The firmware does not yet support the wifi module.

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Adding an LCD display

The uDW board has a 9-pin header matching one-to-one the header of the inexpensive “ili9341” QVGA 2.2” TFT SPI 240x320 LCD module sold on eBay. A set of “Dupont” wires (female-female) can be used for the connection. Driver software for the uDW has been tested, but is not integrated in the current firmware.



Accessing printer signals

The DriveWire connection only uses the ACK, BUSY and STROBE signals on the parallel printer port. Data lines D0-D7 can be freely used for other purposes. The uDW board provides an unpopulated header for accessing these lines.

Board revisions

(Board layouts shown without microcontroller module)

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