High Performance Software Defined Radio
Open Source Hardware and Software Project
Project Description: http://openhpsdr.org
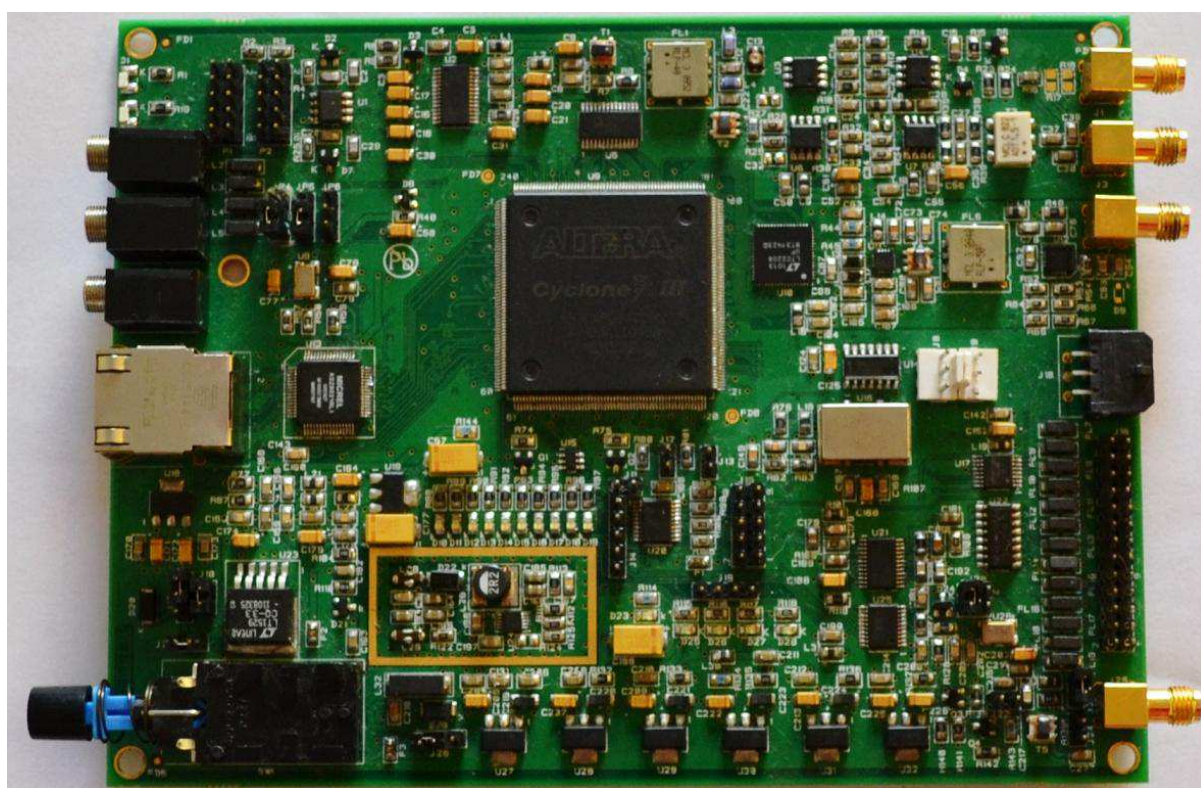
Hermes

Full Duplex HF Transceiver

IMPORTANT

The FPGA and other components on the Hermes PCB can be damaged by Electrostatic Discharge (ESD). When handling the PCB, you should take ESD precautions (e.g. use a work bench with an antistatic mat on it and wear a grounded wrist strap).

Revisions

V1.0	Initial release	28th Feb 2012
V1.1	Replaced reference to .Net 1.1 with .NET3.5	2nd Mar 2012
V1.2	Updated web link to N9VV document	7th Mar 2012

CONTENTS

INTRODUCTION

Hermes is a full duplex, digital-down-conversion (DDC) and digital-up-conversion (DUC) HF transceiver.

Hermes provides either a 100T or Gigabit (1000T) interface to the host PC. The board uses a large 'Altera' Field Programmable Gate Array (FPGA), providing some 40,000 logic elements which give plenty of room for future code updates and new facilities.

All the Ethernet protocol processing is undertaken by the FPGA. Protocols supported include: UDP/IP, DHCP, APR and 'ping'. A unique MAC address is assigned to each board and either a static or automatically assigned IP address can be used.

Future Hermes code updates can be achieved via the Ethernet connection, eliminating the need for special programming adapters.

Hermes can be use with a number of different PC Software Defined Radio programs including those written for Windows, Linux and MacOS X operating systems.

What you will need

Table 1 and Table 2 below summarize the hardware and software you will require to operate a Hermes board

Table 1: Hardware Requirements

Hermes board	Backplane for all HPSDR boards
Power supply	13.8v @ 1A or PC ATX type or equivalent*
Ethernet cable	Connection between Hermes and PC or Ethernet Switch
3.5mm jacks	For connection of PTT, CW key and microphone

*Hermes draws 0.5A from 13.8v at 100T on receive when using the internal 5v SMPSU. This increases to 0.7A when transmitting at 0.5W.

Table 2: Software Requirements

Windows XP or Windows 7	PowerSDR™, KISS Konsole, ghpsdr3
Linux (Ubuntu V10.10)	ghpsdr3
MacOS X	Heterodyne

See http://openhpsdr.org/wiki/index.php?title=HPSDR_related_software for more information on available PC software.

Hermes set-up

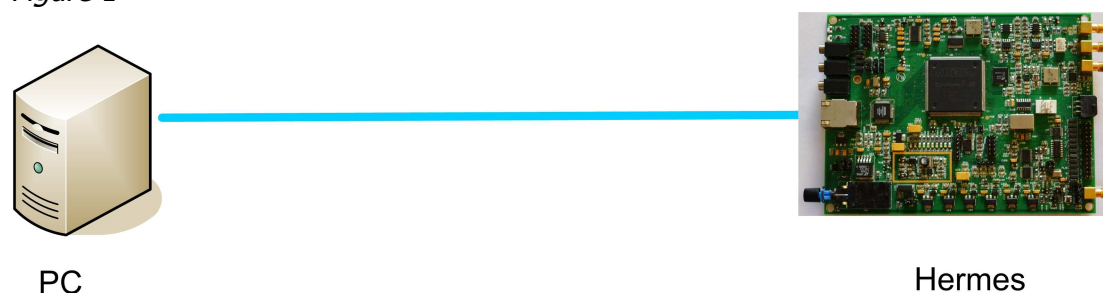## Ethernet Connection

Hermes is connected to a host PC, either:

    a) Directly to a dedicated Ethernet port on a host PC; or

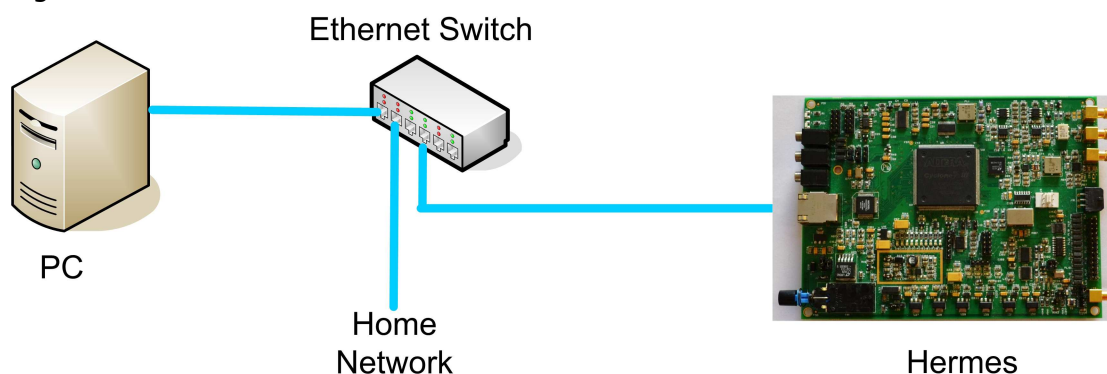   b) To a connection on a *full duplex* Ethernet switch that is also connected to the host PC.

Connection to a dedicated Ethernet port is shown in Figure 1, whilst connection to an Ethernet switch is shown in Figure 2.

Figure 1

PC   Hermes

For direct connection of Hermes to a dedicated Ethernet port, a CAT 5 Ethernet cable is used. Note that a 'crossover' cable is *not* necessary but can be used if desired.

Figure 2

Ethernet Switch

PC

Home
Network   Hermes

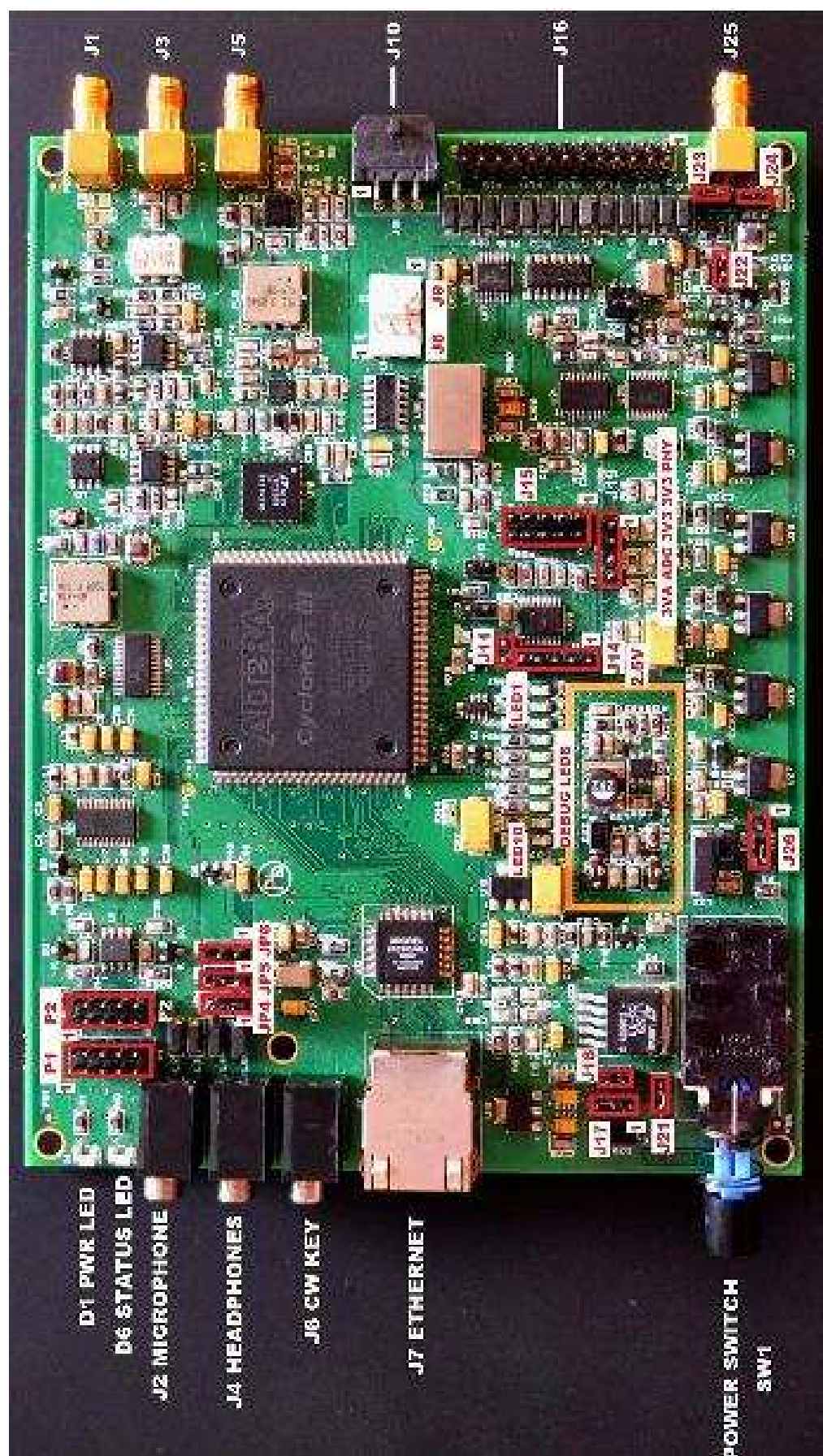For connection of Hermes to an Ethernet switch, a CAT 5 Ethernet cable is used.

IMPORTANT: The Ethernet switch must be capable of operating in *full duplex* mode at 100T or 1000T. The initial release of Hermes FPGA code will operate at 100T, but future releases will run at 1000T. For this reason, a 100T Ethernet switch may be used in the interim, but if a new purchase is planned then a 100/1000T switch is recommended.

Since Hermes operates in full duplex mode, it should *NOT* be connected to an Ethernet hub.

Jumper Settings and Connectors

Hermes provides a number of connectors and user-configurable jumpers; their locations are shown in Figure 3.

Figure 3

8

Labels on the board (left to right / by connector):

J1
J3
J5
J10
J16
J25

D1 PWR LED
D6 STATUS LED
J2 MICROPHONE
J4 HEADPHONES
J8 CW KEY
J7 ETHERNET
POWER SWITCH SW1

Jumper settings

Note that some of the connectors labelled 'J' on the Hermes PCB are for jumpers, while others are for input/output connections. The jumpers are explained in this section of the manual, whilst the input/output connections are detailed in the following section.

J12 - When inserted, this jumper starts the Hermes board in 'bootloader' mode - see Appendix A for details regarding this mode. *For normal operation, this jumper should not be fitted.'*

NOTE: For the initial release (V1.0) of the Hermes FPGA code, jumper J12 should be inserted.

J13 – When inserted, this jumper forces Hermes to run at 100T, even if it is connected to an Ethernet switch or PC capable of running at 1000T. When this jumper is removed, Hermes will run at the maximum speed available on the Ethernet switch or adapter it is connected to, or as determined by the Hermes firmware.

JP4 – This jumper selects the microphone connection, either tip or ring - see the diagram below. Some microphones come with their element wired between a 3.5mm jack plug 'tip' and sleeve (ground), whilst on others the element is wired between a 3.5mm jack plug 'ring' and sleeve (ground).

To select the tip, place the jumper on pins 2 and 3 (default); to select the ring, use pins 1 and 2.

JP5 – This provides bias if you wish to use an electret microphone. If the microphone is connected between to the 3.5mm jack plug 'tip' and sleeve (ground), then place a jumper between pins 2 and 3. If the microphone is connected between the 3.5mm jack plug 'ring' and sleeve (ground), then use pins 1 and 2. If bias is not required then do not fit this jumper (this is the default setting).

JP6 - If your microphone is fitted with a PTT button, then this jumper enables it. If the PTT button is connected between the 3.5mm jack plug 'tip' and sleeve (ground) then place a jumper between pins 2 and 3. If the PTT is connected between the jack plug 'ring' and sleeve (ground) then place the jumper between between pins 1 and 3. If your microphone is not fitted with a PTT, or you do not wish to use it, then do not fit a jumper to JP6 (this is the default setting).

WARNING: If your microphone plug uses tip and sleeve connections only and you set the PTT jumper to the ring setting, then the PTT will be permanently enabled (i.e. the transmitter will be permanently switched on).

NOTES: Ensure that the jumper on JP6 is NOT connected to the same terminal (tip or ring) that your microphone is connected to. The PTT button should present a voltage-free contact that connects its associated pin to the outer sleeve (ground) of the coaxial microphone cable when pressed. This is the most common way of wiring a PTT button, but users are advised to check the connections with a multimeter set to the lowest ohms range if unsure of the exact configuration.

An alternative PTT input connection is available via pin 1 of connector J16.

J17 – When a jumper is placed on pins 2 and 3 (the default setting) this selects the output from the onboard 12V regulator for use with a 13.8V supply. With a jumper on pins 1 and 2, this bypasses the 12V regulator so that a 12V regulated supply may be used with Hermes.

J18 – When a jumper is fitted (the default setting) this enables the onboard 12V regulator for the use of a 13.8V DC supply. This jumper should be removed when a 12V regulated supply is used.

J20 – When a jumper is inserted between pins 1 and 3 (the default setting) the internal 10MHz reference oscillator is selected. When pins 2 and 4 are jumpered, an external 10MHz reference is selected at J25 (see the following 'Input/Output section of this manual).

J21 – When a jumper is in place (the default setting) the internal 5V SMPSU is enabled and should be in place when using a 13.8V or 12V DC supply for the overall power requirements of Hermes. The jumper should be removed when an external 5V supply is used.

J22 - When inserted (the default setting) this jumper terminates an external 10MHz reference with 50 ohms.

J23 - When inserted (the default setting) this jumper enables power to be supplied to the Hermes 10MHz TCXO reference oscillator

J24 – When inserted (default) this jumper connects the outer of J25 to the ground of the Hermes board.

J26 - In position 1 and 2 this enables operation of the 5V circuits of Hermes from an external 5V supply. In position 2 and 3 (the default setting) the internal 5V SMPSU of Hermes is selected.

NOTE: As shipped, the jumpers J17, J18, J21 and J25 in Hermes are configured in the default setting that enables complete operation from a 13.8V DC Power Supply.

Input/Output Connections

J1 – Provides a low-level transmit output for use with a transverter, etc. The output level can be set by the user to an appropriate level by fitting suitable resistors to the spaces for R17 and R18 on the Hermes PCB. These resistor spaces are not populated during production.

J2 – Provides the antenna input to the receive section of Hermes and is nominally 50 ohms impedance.

J3 - Provides the connection to the transmitter RF output of Hermes, which is nominally 500mW into 50 ohms. An antenna may be connected directly to J3 for QRP operation, since the harmonic and other spurious output levels of Hermes meet the relevant FCC requirements as long as the output is maintained at 500mW or less.

Should an external power amplifier be used with Hermes, then the user will need to ensure that this has adequate harmonic suppression.

J4 - Provides connection to stereo headphones via a standard 3.5mm socket. Low impedance headphones may be connected to J4 - the type intended for use with PC sound cards are suitable.

J5 - Provides connection to either an electret or crystal types of microphone. The microphone may be fitted with a PTT button. The ground of the microphone cable should be connected to the common connection of a 3.5mm jack plug. The PTT and signal connections can connect to either the tip or ring of a 3.5mm stereo jack plug, as selected by JP4 and JP6. Should an electret microphone be used, then bias for this can be provided via JP6

J6 - Provides connection for a CW key, either straight, dual-paddle or iambic. If using a dual-paddle or iambic key paddle, the common connection of the key should be made to the sleeve of a 3.5mm stereo jack plug, the 'dot' side to the ring and the 'dash' side to the tip. If a straight key is used this should be connected between the sleeve and tip of the jack plug. Some PC SDR software, e.g. PowerSDR™, enables the dot and dash connections to be reversed via a menu selection.

The dot and dash connections are connected to 3.3V via a 10k resistor.

NOTE: to use a CW key with PowerSDR™ you will need to enable it. To do so, click on Setup in PowerSDR™ and then select the DSP tab followed by the Keyer sub-tab. In the Connections section of PowerSDR™ select Ozy.

J8, J9 - Provides right and left (respectively) channel speaker outputs. Speakers of 8 ohms impedance or more may be connected to pins 1 and 2 of J8 and J9. **WARNING**: These pins are directly connected to the audio output IC and should not be shorted to each other nor to ground.

J10 – Provides a DC power connection. For operation from 13.8V DC supply, connect the 'positive' lead of the supply to pin 1 and the 'negative' lead to pin 2 and ensure the jumper on J18 is in place, the jumper on J17 is connected to pins 2 and 3 and a jumper on J26 connects pins 2 and 3. **NOTE**: As supplied, the Hermes board is configured for operation from a 13.8V DC supply.

For operation from a 12V DC supply, connect the positive lead of the supply to pin 1 of J10 and the negative lead to pin 2 of J10. Ensure that the jumper on J18 is removed, the jumper on J17 is placed on pins 1 and 2, a jumper placed on J21 and a jumper on J26 is placed on pins 2 and 3.

For operation from a 12V DC supply and an external 5V supply, connect the 'positive' lead of the 12V supply to pin 1 of J10 and the 'negative' lead to pin 2 of J10. Connect the positive lead of the external 5V supply to pin 4 of J10 and the negative lead connections to pin 3 of J10. Ensure that the jumper on J18 is removed, the jumper on J17 is placed on pins 1 and 2, a jumper placed on J21 and a jumper placed on pins 1 and 2 of J26.

J11 - Provides an open-drain PTT output that is common with pin 13 of J16 and is intended for use with an external power amplifier or transverter, etc. The output switches to a low impedance whenever the PTT or the MOX/VOX in the PC software is activated. The output is rated at 60V @ 100mA and includes a relay 'back-emf' protection diode.

J14- Provides I/O connections for future expansion

J15 - Provides interfacing to an external power amplifier (e.g. HPSDR Apollo project) or filter bank (e.g. HPSDR Alex project).

J16 -Provides for a number of inputs and outputs as follows:

Pin	Connection
1	PTT - connected to 3.3V via 1k pull-up resistor
2	Left channel line-level audio input
3	Left channel headphones audio output
4	Left channel line-level audio output
5	Right channel line-level audio output
6	User analogue input 0-3v max
7	User digital input 3V max
8	User digital input 3V max
9	User open-collector output 1
10	User open-collector output 3

11	User open-collector output 5
12	User open-collector output 7
13	Open-drain PTT output
14	Ground
15	Right channel line-level audio input
16	Right channel headphones audio output
17	User digital input 3V max
18	No connection
19	User analogue input 0 – 3V
20	No connection
21	User digital input 3V max
22	User open-collector output 2
23	User open-collector output 4
24	User open-collector output 6
25	Open-collector reference/fly-back diodes

The open-collector outputs are rated at 50V and a total current drain of 500mA.

NOTE: The total current drain is the maximum from **all** outputs. Common relay back-emf protection diodes are provided at pin 25 – see ULN2003AD data sheet for more details.

The PTT provided on pin 1 should be connected to a voltage-free contact and can be activated by connecting to ground (or pin 14).

NOTE: The user analogue inputs are rated at 0 – 3V with an absolute maximum input of 3.2V. The input impedance is high (>100k ohms) so if an input is enabled in the PC software but unused it may pick-up signals from an adjacent pin. If this situation occurs, the unused inputs should be grounded.

J19 - Provides high impedance (>100k ohms) analogue inputs for the monitoring of an associated transmitter power amplifier. The input voltage range should be 0 to 3.0V **with an absolute maximum of 3.1V**. Pin connections are as follows:

Pin 1	Ground/0V
Pin 2	Forward Power
Pin 3	Reverse Power
Pin 4	+12V (via a resettable 1A fuse)

J25 – Provides the connection for an external 10MHz reference oscillator. This should preferably be a sine wave of between -10dBm and +10dBm. The input may be isolated from the Hermes ground by removing J24. With a jumper on J22, the input impedance is normally 50 ohms but may be increased to approximately 1k ohm by removing the jumper.

P1 -Provides an Altera JTAG interface for FPGA programming and is intended for experienced users.

P2 - Provides an Altera serial configuration interface for EEPROM programming and is intended for experienced users.

OPERATION

Connect Hermes to an ethernet port on an Ethernet Switch or directly to the personal computer that will be used with the transceiver.

Connect Hermes to a 13.8V DC supply (the default setting) or to 12V/5V supply and depress the power-on button.

The following LEDs indicate the status of the Hermes board (see Figure 3 for the location of the various LEDs).

When Hermes is powered-up, the following power supply LEDs should be alight:

D1   – 3.3V supply OK
D23   – 2.5V supply OK
D25   – 3.3V supply OK
D26   – 3.3V supply OK
D27   – 3.3V supply OK
D28   – 3.3V supply OK

The meaning of the other LEDs is as follows:

LED1   - Lights when an Ethernet broadcast is detected.
LED2   - Lights when traffic to the board's MAC address is detected.
LED3   - Lights when detecting a received sequence error or the ASMI is busy.
LED4   - Displays state of PHY negotiations – there is a fast flash if no Ethernet connection; a slow flash if 100T; and a steady 'on' if 1000T.
LED5   - Lights when the PHY receives Ethernet traffic.
LED6   - Lights when the PHY transmits Ethernet traffic.
LED7   - Displays state of DHCP negotiations or static IP – the LED is on if ACK; displays a slow flash if NAK; fast flash if time out; and long flash then short flash if static IP.
LED8   - Lights when sync (0x7F7F7F) is received from the personal computer.
LED9   - Lights when a Hermes discovery packet is received.
LED10 - Lights when a Hermes discovery packet reply is sent.

Status_LED - Flashes once per second

NOTE: The meaning of each LED is controlled by firmware, hence the meanings may change in future releases of firmware. Whenever you change the firmware, check the associated release notes to confirm the meaning of each LED.

When first powered-on, Hermes will attempt to obtain an IP address from a DHCP server (if one is attached to the network). If this is successful, then LED7 will be steadily illuminated. Note: it may take up to eight seconds for a DHCP IP address to be assigned.

If a DHCP server is not found on the network, or Hermes is connected directly to a PC, then an APIPA IP address in the range 169.254.x.x will be assigned. Note this will be assigned after Hermes' attempts to obtain a DHCP IP address has failed, so will take eight seconds from powering-on the Hermes board. The time that a personal computer takes to obtain an APIPA address *itself* varies with the particular operating system. Tests using Windows XP indicates this can be up to 20 seconds.

If an APIPA IP address is assigned, then LED7 will flash rapidly.

The user may also set a static IP address (see Appendix A). In this case, a DHCP IP address will not be sought and LED7 will flash alternately short/long.

If a static IP address is assigned and Hermes is connected to a second ethernet port on a personal computer, then the address assigned must be on a different sub net. For example, if the first port on the personal computer is using 192.168.x.x then use 10.x.x.x for the Hermes and the second port.

By assigning an IP addresses to the second ethernet port and Hermes the (sometimes-long) delays in obtaining an APIPA IP address can be eliminated.

The PC SDR code may then be started. A Hermes board that is ready to communicate with a PC will respond to 'ping' and ARP requests.

SOFTWARE

SDR Software

If you are in any doubt as to the ability of your computer to support PowerSDR™ and Hermes, please see Appendix B of this manual.

The HPSDR version of PowerSDR™ requires that your system have Microsoft's .NET Framework version 3.5 installed. Most systems with Microsoft XP installed already have the framework, so try installing PowerSDR™ with what you have on your computer. However, if required, NET Framework 3.5 can be obtained by clicking on the link below:

.NET V3.5

The following text explains how to download and install a version of PowerSDR™ that has been developed by Doug Wigley, W5WC.

You can obtain the latest release of Doug's software from the open-source development tree. The repository is managed by Subversion, which is a popular collaborative software/firmware development tool for open-source projects. To access this software you will need to install and use a Subversion (SVN) client, see the section called 'How to use SVN. There are several available - TortoiseSVN for Windows has proven reliable and can be downloaded from here:

TortoiseSVN

Once TortoiseSVN is installed, follow these steps:

1. Create the following directory structure
    C:\HPSDR\Hermes
    (this is an arbitrary convention, but logical and easy to find)
2. Navigate to HPSDR -
    Click Start and select Run...
    Type: C:\HPSDR then [Enter]
    You should see a Hermes directory in the window that opens.
3. Download the latest software -
    Right click on the Hermes directory
    Select SVN Checkout...
    Type or 'copy and paste' the following line into the "URL of repository" field:

svn://svn.openhpsdr.org/svn/repos_sdr_hpsdr/trunk/W5WC/PowerSDR_HPSDR_2/bin/Release

4. Click OK. At this point, TortoiseSVN should begin downloading the most current released version of the PowerSDR™ client for HPSDR. Once it completes, go to step 4. Note that to update to subsequent releases, you can right-click the Hermes directory and select SVN Update.

5. Copy the files to a working directory for better version control. This directory can be anywhere you like, but we recommend using C:\Program Files\FlexRadio Systems\HPSDR\. If you are updating an existing installation, make sure PowerSDR is not running before you write over the old version.

6. To create a PowerSDR desktop shortcut, you can open the working directory where you copied the files (i.e. C:\Program Files\FlexRadio Systems\HPSDR\), locate the PowerSDR application file (PowerSDR.exe), right-click on PowerSDR.exe then 'drag and drop' it to your desktop. Select "Create Shortcuts Here".

Details of alternative PC software for use under Windows, Linux and MacOS can be found at: http://openhpsdr.org/download.php

Please refer to the relevant software documentation for using Hermes with other SDR applications.

Software installation

After installing PowerSDR™, click on PowerSDR.exe. For a new installation a calibration program will run that relates to the Fast Fourier Transform code. Once run, the user will be prompted to select the appropriate hardware, select HPSDR and on the components screen select Mercury.

Software Configuration

Run PowerSDR™, select Setup, click the General tab then Hardware Config. Within the 'Radio Model' box, select Hermes as follows:

Radio Model
- FLEX-5000
- SDR-1000
- Soft Rock 40
- Demo/None
- HPSDR
- ● HERMES

Press the Start button on PowerSDR™ whereby the Hermes board will automatically be detected. PowerSDR™ will display the IP address and MAC address of the Hermes xoard it is connected to. On the Hardware Config form this is displayed within -Hermes Address- as follows:

Hermes Address
IP: 0.0.0.0   Ver: 00
MAC: 00:00:00:00:00:00   ID: 00
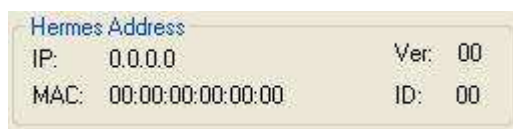
Make a note of the unique MAC address since this will be useful if there is a need for problem-solving in the future.

If an HPSDR Alex low-pass filter/high-pass filter board or HPSDR Apollo power amplifier (currently under development) is connected to Hermes, then check the Alex box in the HPSDR 'Hardware Present' section of the form.

Both the frequency and level calibrations for Hermes have already been programmed, but if you wish to use your own settings, or re-calibrate, then use the General/Calibration tab to do so.

If the open-collector outputs on connector J16 are being used, they may be activated using the General/Penny/Hermes Ctrl tab. Click on the 'Ext Control' button to activate the controls.

A 'tick' in a box indicates that the open-collector output(s) will 'pull low' when the band and receive and/or transmit combination is met.

In the example below, the open-collector outputs 1 and 4 will be pulled low when receiving on 160m; while the open-collector output 2 will be pulled low when transmitting on 160m.

When using an external power amplifier for transmitting, it is useful to calibrate PowerSDR™ so that the amplifier gives the same power-out for the same setting of the Drive Control. The Setup Form enables any variations in power amplifier gain with frequency to be compensated.

The 'Gain By Band' can be varied by adjusting the settings on the PA Settings tab – see diagram below.
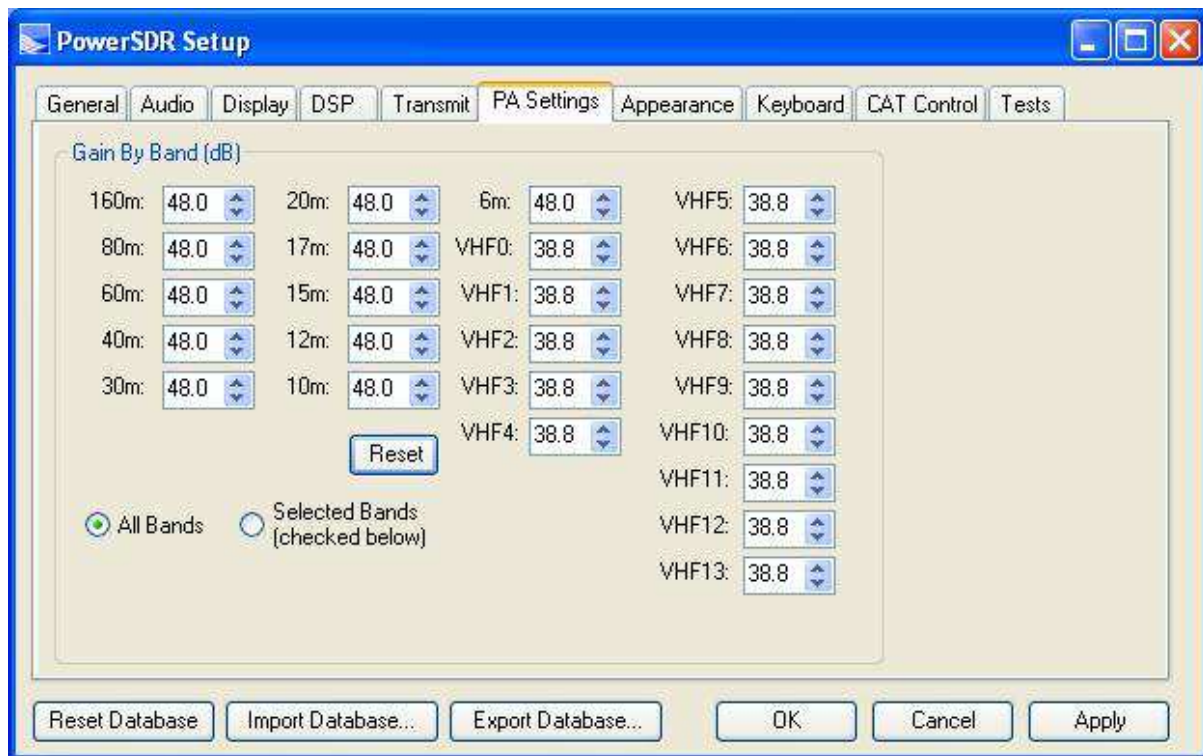
Increasing the values, indicating a higher power amplifier gain, reduces the power output.

Depending on the processing power of the personal computer you are using with Hermes, it may be necessary to run PowerSDR™ at a higher priority. For example, if gaps in the receive audio are present when operating at a 192kHz sampling rate, then try increasing the Process Priority. This can be set by selecting Setup, General, Options and within Process Priority select 'Above Normal' or 'Real Time'. Note there appears to be an issue with selecting 'Real Time' - please be aware of this.

Please refer to the PowerSDR™ users guide for guidance in the operation of all other controls. The guide can be obtained from: www.flex-radio.com

View any Flex Owner's Manual.pdf to learn more regarding the use of the PowerSDR™ software.

SUPPORT

Technical support for Hermes via email is available via the HPSDR mail reflector. Instructions relating to joining the reflector are here:
http://lists.openhpsdr.org/listinfo.cgi/hpsdr-openhpsdr.org

The archives may also be searched here:
http://lists.openhpsdr.org/mmsearch.cgi/hpsdr-openhpsdr.org

The latest version of this User Manual can be obtained from
http://openhpsdr.org/documents.php

Schematic

The current schematic of Hermes can be downloaded from:

http://openhpsdr.org/support.php#Hermes

Additional reading

Ken Hopper, N9VV, has provided an excellent introduction to Hermes here:
http://www.n9vv.com/Images/Hermes/Hermes%20an%20Introduction%20October%202011.pdf

His document covers some of the history of the project, as well as some technical explanations.

UPDATING HERMES FIRMWARE

The firmware used to control the Hermes board is held in an EEPROM on the PCB. The firmware can be updated to the latest version via the Ethernet connection and the HPSDRProgrammer personal computer software.

To update, install the Windows version of HPSDRProgrammer software from
http://openhpsdr.org/download.php.

You will also need to download and install the Winpcap drives and dlls from the link on the same page.

Before installing new firmware, ensure that all personal computer SDR software you are using has been stopped and the application closed.

Run the HPSDRProgrammer software which will result in the following screen being displayed):
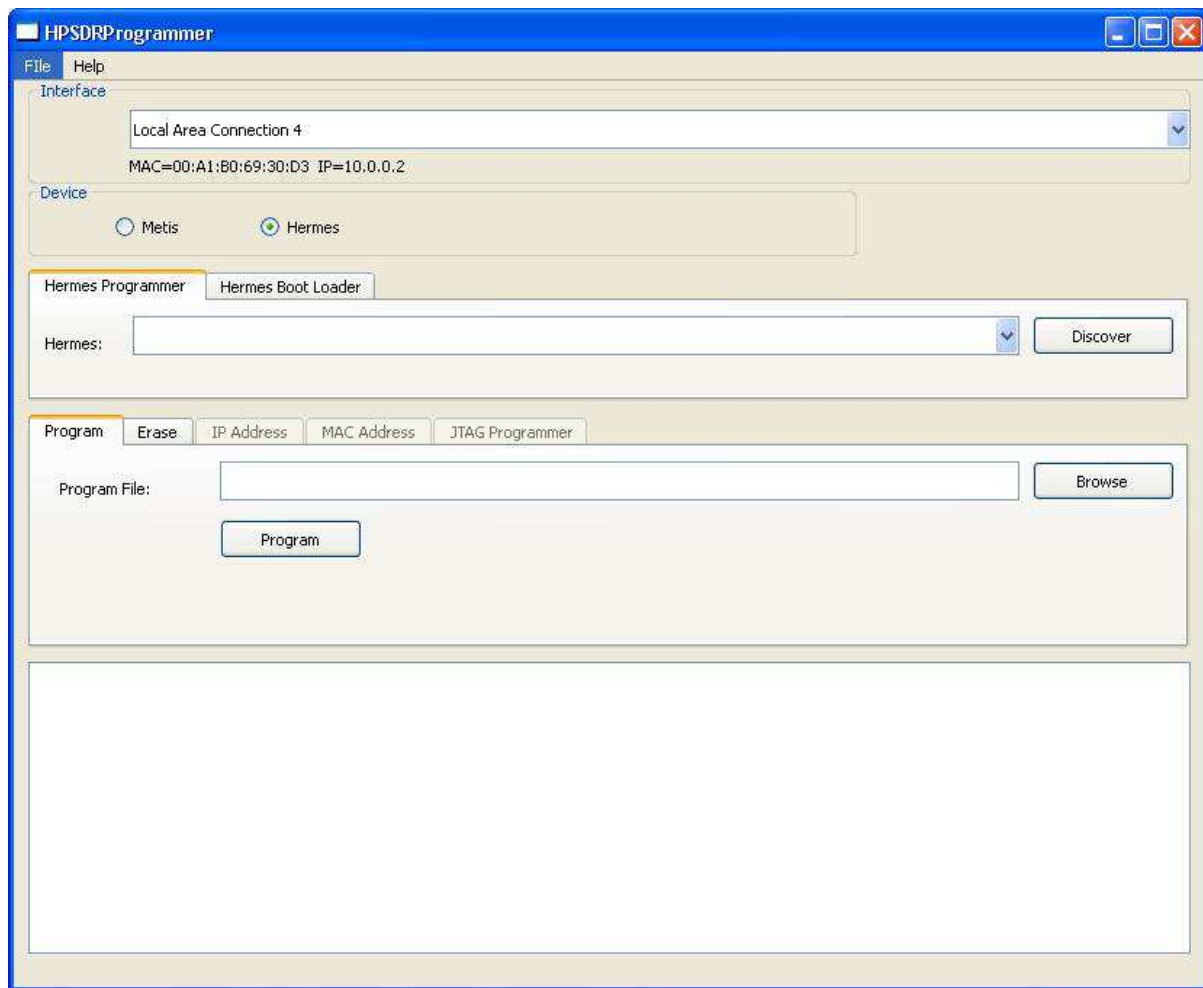
The 'Interface' section will list the Ethernet adapters present on the PC. If there is more than one found, then use the drop-down menu to select the adapter that the Hermes board is connected to.

The IP address that the adapter is using is displayed beneath the entry to assist with selecting the correct one. The Linux version will display available adapters using eth0, eth1 etc. and MacOS X en0, en1, en2, etc.

In the 'Device' section, select Hermes and check that the 'Hermes Programmer' Tab is selected.

Click the 'Discover' button - this will locate any Hermes board(s) that the PC is able to access. If more than one Hermes board is located, then the board to be programmed may be selected using the drop-down menu in the 'Hermes Programmer' section.

The successful discovery of a Hermes board will be indicated as follows:
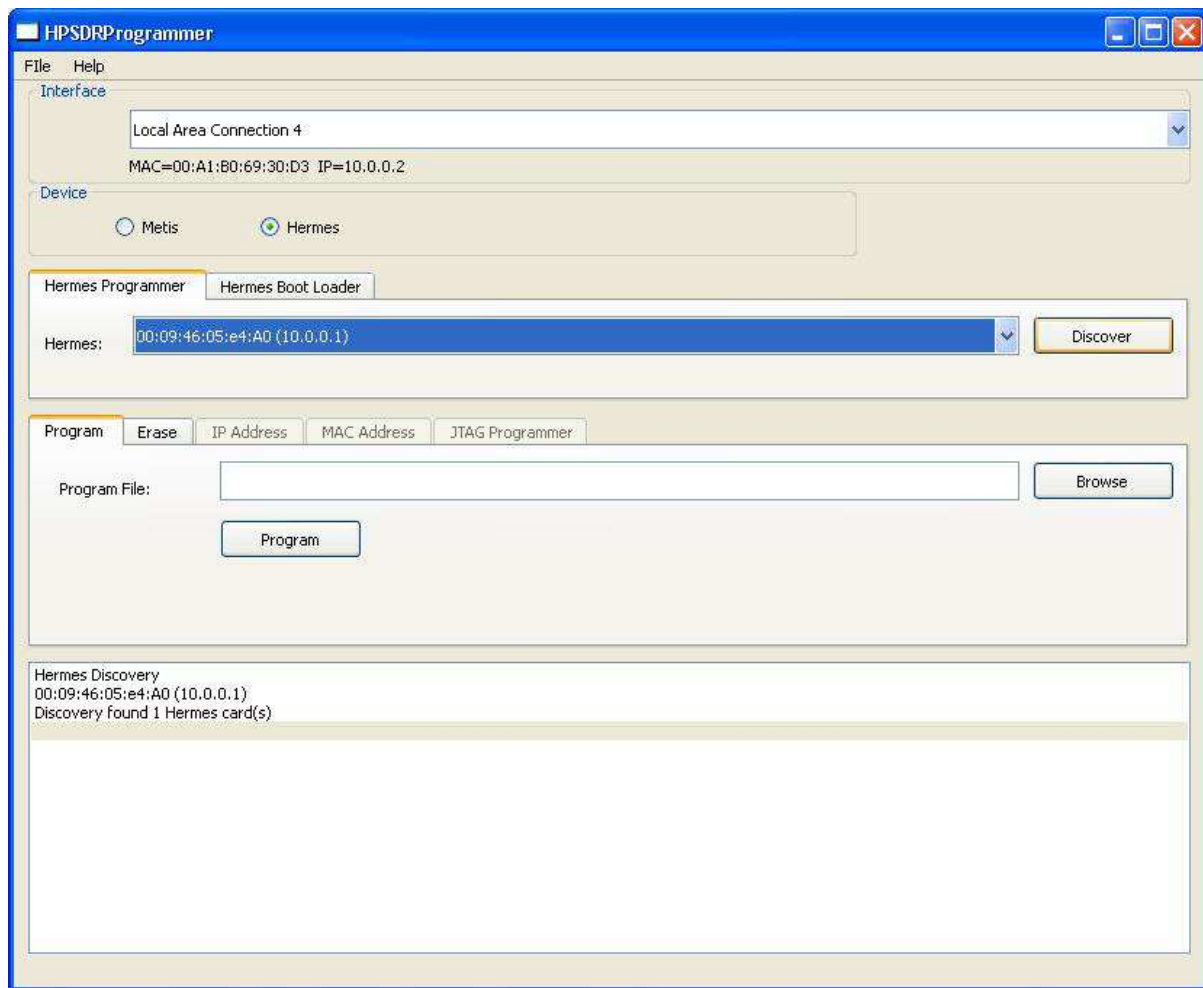
To program the selected Hermes board, check that the 'Program' Tab is selected. Use the 'Browse' button to locate the Hermes_Vx.x.rbf file that is to be loaded into the Hermes flash memory. The most recent Hermes_Vx.x.rbf file can be found at http://openhpsdr.org/download.php.
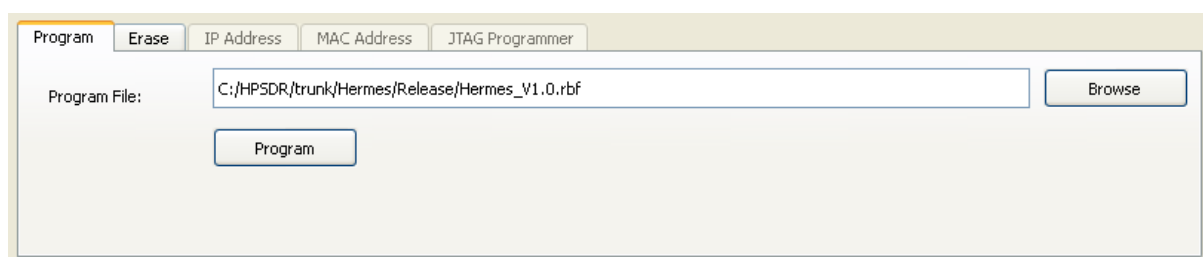
Click on the 'Program' button to start the erase and programming cycle. A successful erase and program will be indicated as follows:

```
reading file...
file read successfully
Erasing device ... (takes several seconds)
Device erased successfully
Programming device ...
Programming device 20% written ...
Programming device 40% written ...
Programming device 60% written ...
Programming device 80% written ...
Programming device 100% written ...
Programming device completed successfully
```
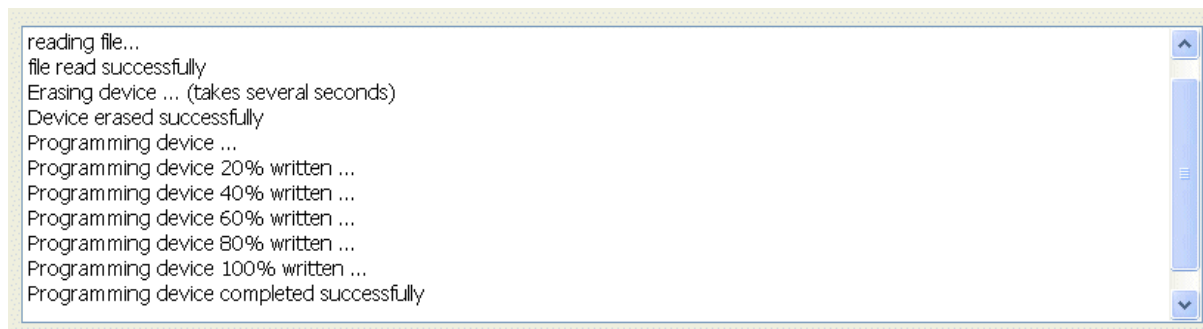
Once the new firmware has been successfully loaded, Hermes will automatically load and run the new code. Should the new firmware not load or operate correctly then please refer to Appendix A for further instructions.

HPSDRProgrammer may also be used to erase the EEPROM on a Hermes board. In this case, select the 'Erase' Tab and click the 'Program' button. Once the EEPROM has been erased the Bootloader facility (see Appendix A) must be used to re-program it.

APPENDIX A

This appendix explains how to set a static IP address and use the Hermes Bootloader facility. *Note that in order to use these facilities, you need to be running with Administrator privileges under Windows, root under Linux. The MacOS X version will automatically set the correct privileges.*

Setting a Static IP Address

This section explains how to set a static IP Address on a Hermes board. This facility is provided for advanced users who understand the implications of using a static IP Address.

1.   Remove the power from Hermes and connect a jumper to J12 - this places Hermes into Bootloader mode. Re-apply power to Hermes.

2,   Ensure that any SDR software has been stopped and terminated. Load the HPSDRProgrammer software, select the appropriate interface then select the 'Hermes Boot Loader' tab.

3.   Select the 'IP Address' tab, enter the desired IP address in xxx.xxx.xxx.xxx format then click 'Write'. Then click the 'Read' button and check that the information area displays the desired IP address. The result of programming the IP address 10.0.0.1 is shown below.
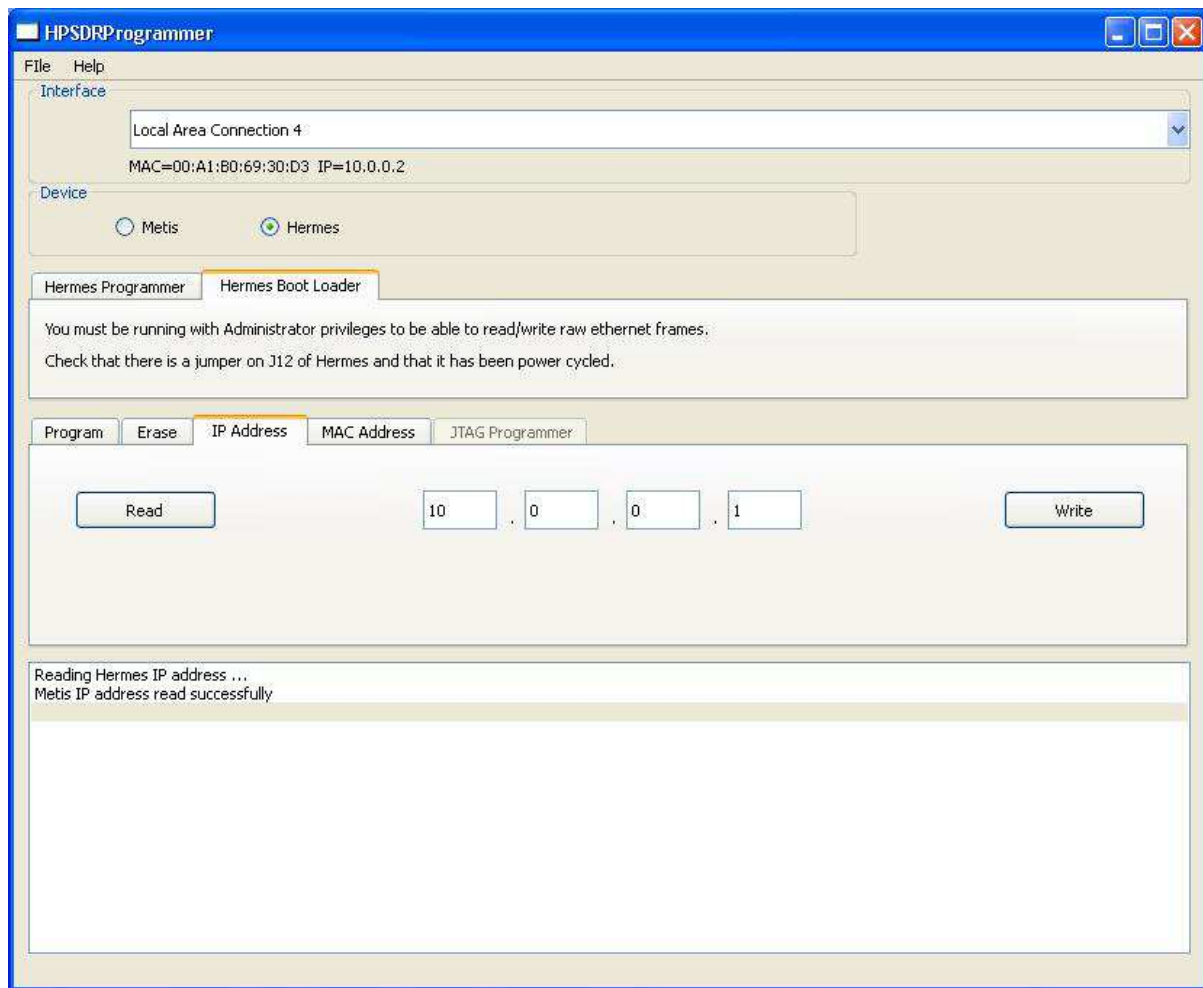
Note that if an IP address of 0.0.0.0 or 255.255.255.255 is set, then Hermes will ignore the setting and instead attempt to obtain a DHCP or APIPA IP address.

Remove the power from Hermes then remove the jumper on J12. Re-apply power to Hermes.

Reloading the EEPROM

The normal procedure for updating the EEPROM on Hermes is by using the in-line programmer function as described in 'Updating Hermes Firmware'. However, should this fail for some reason or a Hermes board is received in an unknown state, then the EEPROM may be updated using the following method:

1.   Ensure that any SDR software has been stopped and terminated. Load the HPSDRProgrammer software and select the 'Hermes Boot Loader' tab.

2.   Remove the power from Hermes and connect a jumper to J12 - this places Hermes into Bootloader mode. Reapply power to Hermes.

3.   Ensure that the 'Program' tab is selected then use the 'Browse' button to select the Hermes_Vx.x.rbf file that you wish to load into the EEPROM. Click 'Program' and the EEPROM will be erased and programmed.

4.   Remove the power from Hermes then remove the jumper on JP12. Reapply power to Hermes to load the new code into the FPGA.

The following image indicates the result of successfully programming Hermes.
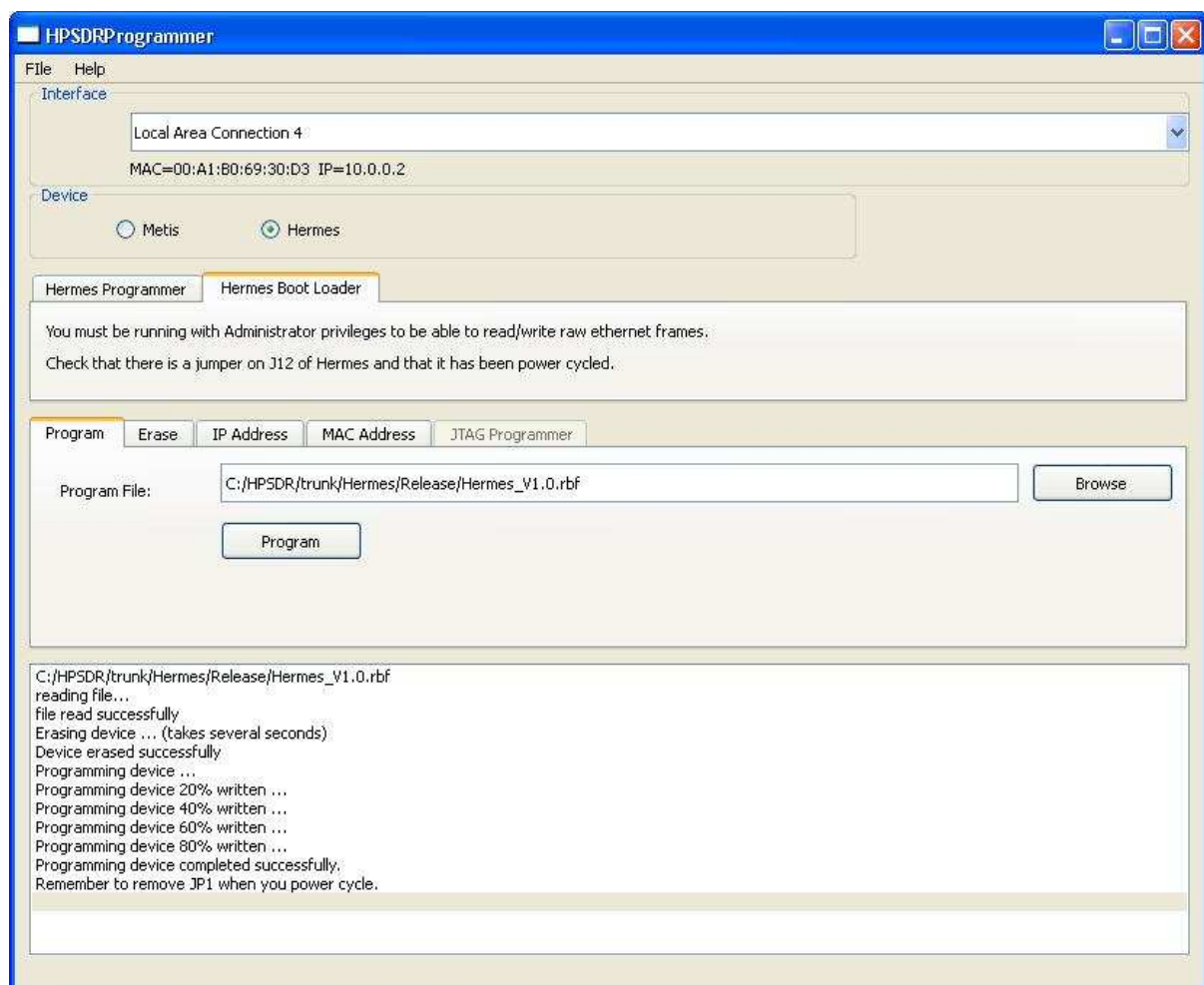
Additional information

A detailed description of the protocol used by Hermes, which is the same as that used by the HPSDR Hermes Ethernet board, can be found in the document 'Metis – how it works.pdf' which can be found at http://openhpsdr.org/support.html.

APPENDIX B

Computer Performance

Processing of streaming data in real-time can be a challenging task for Windows-based applications and device drivers. This is because by design Windows is not a real-time operating system. There is no guarantee that tasks can be executed in a deterministic (timely) manner.

Audio or video data streams transferred from or to an external device are typically handled by a kernel-mode device driver. Data processing in such device drivers is interrupt-driven. Typically, the external hardware periodically issues interrupts to request the driver to transfer the next block of data. In Windows NT-based systems (Windows 2000 and later) there is a specific interrupt handling mechanism. When a device driver cannot process data immediately in its interrupt routine, it schedules a Defined Procedure Call (DPC).

Microsoft defines them as: *A Deferred Procedure Call (DPC) is a queued call to a kernel-mode function that will usually be executed at a later time. DPCs are used by drivers to schedule I/O operations that do not have to take place in an ISR at a high IRQL, and can instead be safely postponed until the processor IRQL has been lowered.*

When you look at Windows Task Manager and sort the running processes by CPU (Processor Utilization), the System Idle Process is almost always at the top of the list. What you may not know is that 'process' is really a roll-up of several things. Among other things included in that CPU number, is hardware interrupts and DPCs. You can see these two items by using the Microsoft "SysInternals" Process Explorer available here: Process Explorer

Thesycon's DPC Latency Checker is a free Windows tool that analyses the capabilities of a computer system to handle real-time data streams properly. It may help you to determine if your personal computer is capable of powering your HPSDR system or to find the cause for interruptions in real-time audio and video streams, also known as 'drop-outs'. The program supports Windows 2000, Windows XP, Windows XP x64, Windows Server 2003, Windows Server 2003 x64, Windows Vista, Windows Vista x64, Windows 7 32 bit and 64 bit and is available here: DPC Latency Checker