The XDS110 ETHDR is an add-on expansion module to the XDS110 Debug Probe that provides an enhanced HDR (high dynamic range) EnergyTrace™ (ET) capability to the capability that exists on the base XDS110 Debug Probe.

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1 Overview

The XDS110 ETHDR is an add-on expansion module to the XDS110 Debug Probe. It provides an enhanced HDR EnergyTrace (ET) capability to the capability that exists on the base XDS110 Debug Probe.

1.1 XDS110 ETHDR Feature Summary

- Target supplied power From 1.8 V to 3.6 V
  - Up to 800 mA
- Power profiling features
  - Support for TI EnergyTrace HDR in two ranges:
    - 1 µA to 120 mA – Higher accuracy but lower peak current
    - 1 µA to 800 mA – Higher peak current but lower accuracy
  - Current sampling at 256k sample per second

1.2 XDS110 ETHDR System Summary

The following features are for the combined XDS110 Probe with the XDS110 ETHDR system:

- Host platforms supported:
  - The system supports various versions of Windows®, OS X™, and Linux® operating systems. Consult the documentation for CCS and other development environments for more details.
- IDE versions supported:
  - TI CCS v7.0 and later
  - IAR (see IAR documentation)
  - Keil (see Keil documentation)
- TI platforms, devices, and ISAs supported:
  - MSP432 MCUs
  - CC26xx/13xx Wireless MCUs
  - CC32xx/31xx Wi-Fi® MCUs
  - TM4C12x MCUs
1.3 **XDS110 ETHDR Overview**

Figure 1 shows a high-level diagram of the major functional areas and interfaces of the XDS110 Probe XDS110 ETHDR system. Details of these are described in Section 2.

![Figure 1. XDS110 Probe High-Level Block Diagram](image)

1.4 **XDS110 ETHDR Parts List**

The XDS110 ETHDR system consists of the following hardware:
- The XDS110 ETHDR add-on pod
- USB cable (only used for auxiliary power to the ETHDR)

1.5 **PCB Breakoff Sections and Compliance**

The different sections of the EVM may be broken apart for ease of prototyping and development. Note that breaking apart the sections voids the warranty. In addition, the stated performance and compliance specifications of the EVM cannot by guaranteed when sections have been broken apart.

If provided, the shielded USB cable is longer than 3m in length. If not, and one is to be purchased for use with this EVM, it is required to be no longer than 3m to retain the stated performance and compliance.
1.6 Environmental Information

Supply voltage: 4.75 V to 5.5 V at 500 mA
Temperature: 0°C to 40°C
Humidity: 50% RH
2 Probe Interfaces

2.1 USB Power Interface

Additional power for the XDS110 ETHDR add-on is provided through a female Micro-USB B-type connector. The USB interface provides additional power to the entire system, and no additional functionality. For target systems drawing more than 400 mA, connect this USB connector to a power source providing at least 500 mA at 5 V DC.

2.2 Probe Expansion Header

The XDS110 ETHDR interfaces to the XDS110 system through the probe expansion header. The header exposes a number of functional interfaces of the TM4C129 debug control CPU, as shown in Figure 2. The use of these signals is reserved for the ETHDR or other add-on modules designed by TI, or designated third parties.

2.2.1 Physical Connection for the Expansion Interface

The XDS110 ETHDR supports a 30-pin IDC male socket with .100-inch pitch. The signal mapping for this connection can be found in Figure 2.

<table>
<thead>
<tr>
<th>Alternate Function(s)</th>
<th>Tin Pin</th>
<th>XDS110 Signal Name</th>
<th>Pin</th>
<th>XDS110 Signal Name</th>
<th>Tin Pin</th>
<th>Alternate Function(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA0 (P0), ADC (A11), DCS Data</td>
<td>120</td>
<td>ET_SSCCLK</td>
<td>1</td>
<td>2</td>
<td>ET_PH0</td>
<td>107</td>
</tr>
<tr>
<td>GPA0 (P4), ADC (A18), DCS Clock</td>
<td>121</td>
<td>ET_SSCSS</td>
<td>3</td>
<td>4</td>
<td>ET_PH1</td>
<td>108</td>
</tr>
<tr>
<td>GPA0 (P4), ADC (A19)</td>
<td>123</td>
<td>ET_SSDAT0</td>
<td>5</td>
<td>6</td>
<td>ET_PH2</td>
<td>109</td>
</tr>
<tr>
<td>GPA0 (P5), ADC (A18)</td>
<td>124</td>
<td>ET_SSDAT1</td>
<td>7</td>
<td>8</td>
<td>ET_PH3</td>
<td>110</td>
</tr>
<tr>
<td>Ground</td>
<td>9</td>
<td>10</td>
<td>GND</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADC (A10), GPA0 (P0)</td>
<td>13</td>
<td>ET_AIN1</td>
<td>11</td>
<td>12</td>
<td>ET_SDA</td>
<td>112</td>
</tr>
<tr>
<td>GPA0 (A0), GPA0 (P1)</td>
<td>14</td>
<td>ET_AIN2</td>
<td>13</td>
<td>14</td>
<td>ET_SDO</td>
<td>113</td>
</tr>
<tr>
<td>GPA0 (P0), CAN H/L, UART RX, DCS Clock</td>
<td>15</td>
<td>ET_Pin</td>
<td>15</td>
<td>16</td>
<td>ET_PPE2</td>
<td>76</td>
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<td>GPA0 (P4), UART RX</td>
<td>17</td>
<td>ET_PGA</td>
<td>17</td>
<td>18</td>
<td>ET_PGB</td>
<td>32</td>
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<td>GPA0 (P0), CAN TX, UART TX, DCS Data</td>
<td>19</td>
<td>ET_Pin</td>
<td>19</td>
<td>20</td>
<td>ET_PCS</td>
<td>37</td>
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<tr>
<td>MOD_NON_ET_VCC_SUPPLY</td>
<td>21</td>
<td>DEBUG_TARGET_VOLT_IN</td>
<td>23</td>
<td>24</td>
<td>DEBUG_TARGET_VOLT_IN</td>
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<tr>
<td>Ground</td>
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<td>26</td>
<td>GND</td>
<td>Ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital 3.3V</td>
<td>ESV3</td>
<td>27</td>
<td>28</td>
<td>ESV3</td>
<td>Digital 5V</td>
<td></td>
</tr>
<tr>
<td>Digital 3.3V</td>
<td>ESV3</td>
<td>29</td>
<td>30</td>
<td>ESV3</td>
<td>Digital 5V</td>
<td></td>
</tr>
</tbody>
</table>
3 Functional Description and Operation

3.1 Physical Connection

The XDS110 ETHDR is connected to the XDS110 Debug Probe by stacking the enclosures, as shown in Figure 3 and Figure 4.

Figure 3. Stacking the ETHDR on the XDS110 Probe

Figure 4. The XDS110 Probe and ETHDR System
The target power and debug connections are managed through the existing debug and AUX connectors on the XDS110 Probe. No direct connection between the ETHDR and the debug target exists.

3.2 **Basic Setup for the Debug Connection**

The presence of the XDS110 ETHDR does not impact the basic debug connectivity of the system, and the instructions in Section 3.1 of the *XDS110 Debug Probe Users Guide (SPRUI94)* are still valid.

3.2.1 **Probe Supplied Power and ETHDR**

The addition of the ETHDR enables the XDS110 Debug Probe to supply current up to 800 mA. No additional steps are required to support this, and the power configuration steps in Section 3.1.2.2. of the *XDS110 Debug Probe Users Guide (SPRUI94)* are still valid.

3.3 **Energy Trace HDR**

3.3.1 **Introduction**

When combined with the XDS110 Debug Probe, the XDS110 ETHDR provides an enhanced system that can be used for measuring the current consumption of the target. These current consumption measurements can be used to develop power and energy use profiles of the target system. The ETHDR expands the ET capabilities of the XDS110 Debug Probe, and these may be required for higher current use cases, or when precise temporal correlation of power transitions is required. Table 1 shows a high level comparison of the capabilities of the two ET capture types.

<table>
<thead>
<tr>
<th>Capability</th>
<th>Base ET on XDS110 Probe</th>
<th>ETHDR</th>
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</thead>
<tbody>
<tr>
<td>Measurement range</td>
<td>500 nA to 100 mA</td>
<td>• 1 µA to 120 mA – low current high accuracy &lt;br&gt;• 1 µA to 800 mA – high current range lower accuracy range</td>
</tr>
<tr>
<td>Sampling frequency</td>
<td>2 ksp s</td>
<td>256 ksp s</td>
</tr>
<tr>
<td>Supply ripple</td>
<td>Some ripple due to SW DCDC</td>
<td>None</td>
</tr>
</tbody>
</table>

3.3.2 **Specifications**

Other than accuracy and sampling frequency, the specifications for a system utilizing the XDS110 ETHDR are identical to the ET specifications found in the *XDS110 Debug Probe Users Guide (SPRUI94)*.

3.3.2.1 **Accuracy**

Table 2 lists the accuracy and range of the ETHDR.

<table>
<thead>
<tr>
<th>Range</th>
<th>Accuracy</th>
<th>Range</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 µA to 15 µA</td>
<td>±700 nA</td>
<td>1 µA to 70 µA</td>
<td>±3.5 µA</td>
</tr>
<tr>
<td>15 µA to 120 mA</td>
<td>±5%</td>
<td>70 µA to 800 mA</td>
<td>±5%</td>
</tr>
</tbody>
</table>

3.3.2.2 **Sampling Frequency**

The XDS110 ETHDR samples target current consumption a 256k samples per second. Thus, the system can reliably catch target power transitions that last 10 microseconds or longer.

3.3.3 **Hardware Setup**

Other than the stacked connection of the XDS110 Probe and the XDS110 ETHDR, the hardware setup is identical to that which is described in Section 3.1 of the *XDS110 Debug Probe Users Guide (SPRUI94)*.
3.3.4 XDS110 ETHDR Usage in Code Composer Studio

When the XDS110 ETHDR is attached to the XDS110 Debug Probe, the ETHDR is used as the power measurement system. The procedure for configuring an ET session, capturing, and displaying data are identical to that defined in Section 3.6 of the *XDS110 Debug Probe Users Guide (SPRUI94)*, with the exception noted below.

3.3.4.1 CCS Setup for ETHDR

The ETHDR supports two capture ranges, as noted above. The selection changes the size of the shunt resistor used to measure the target current consumption. The desired range must be specified in the EnergyTrace Technology Preferences dialog that is reached through CCS → Advanced Tools → EnergyTrace Technology. *Figure 5* shows this dialog, and highlights the selection radio buttons.
3.3.5  XDS110 ETHDR Usage With Command Line Utility – soctune

The Windows-based CCS installation has an interactive command line utility called stune which can be used for capturing EnergyTrace data to a CSV file. The procedure for using stune is the same as defined in Section 3.6.5 of the XDS110 Debug Probe Users Guide (SPRUI94), with the addition that the ETHDR capture range can be specified using the range option –r "lo | hi" with the energytrace command. The "lo" range selection maps to “Low current, narrower range higher accuracy” and the “hi” range selection maps to “High current, wider range lower accuracy”. If the range option is not specified, the range is set to “lo” by default.
For example:

To capture 5 seconds of EnergyTrace with the range set to low range enter the following command:

```
energytrace -D 5000 -o output.csv -r lo et
```

The –D option specified the time in milliseconds.
The –o option specifies the output filename. The file format is fixed as CSV.
The –r option specifies the range low (lo) or high (hi).

To capture 5 seconds of EnergyTrace with the range set to high range enter the following command:

```
energytrace -D 5000 -o output.csv -r hi et
```

The –D option specified the time in milliseconds.
The –o option specifies the output filename. The file format is fixed as CSV.
The –r option specifies the range low (lo) or high (hi).
# Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

<table>
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<tr>
<td>• Removed XDS110 ETHDR Performance section.</td>
<td>2</td>
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<tr>
<td>• Added PCB Breakoff Sections and Compliance section.</td>
<td>3</td>
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<tr>
<td>• Added Environmental Information section.</td>
<td>4</td>
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<tr>
<td>• Updated ETHDR Measurement Performance table.</td>
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<tr>
<td>• Added XDS110 ETHDR Usage Usage With Command Line Utility – soctune section.</td>
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