FEATURES

- Single Chip Fast Data Transfer Solution
- Send / Receive Data over USB at up to 1 M Bytes / sec
- 384 byte FIFO Transmit buffer / 128 byte FIFO receive buffer for high data throughput
- Simple interface to CPU or MCU bus
- No in-depth knowledge of USB required as all USB Protocol is handled automatically within the I.C.
- FTDI’s Virtual COM port drivers eliminate the need for USB driver development in most cases.
- Compact 32 pin (7mm x 7mm) MQFP package
- Integrated 6MHz - 48MHz Clock Multiplier aids FCC and CE compliance
- Integrated 3.3v Regulator – No External Regulator Required
- 4.4v .. 5.25v Single Supply Operation
- UHCI / OHCI Compliant
- USB 1.1 Specification Compliant
- USB VID, PID, Serial Number and Product
- Description Strings in external E2PROM.
- Virtual COM Port Drivers for –
  - Windows 98 and Windows 98 SE
  - Windows 2000
  - Windows Millennium **
  - Apple iMAC **
  - Linux **

APPLICATION AREAS

- USB ISDN and ADSL Modems
- High Speed USB BizCard Readers
- USB I/F for Digital Cameras
- USB I/F for MP3 players
- High Speed USB Instrumentation
- USB ⇒ USB data transfer cables
- USB ⇒ USB null-modem cables
- USB ISDN and ADSL Modems
- High Speed USB BizCard Readers
- USB I/F for Digital Cameras
- USB I/F for MP3 players
- High Speed USB Instrumentation
- USB ⇒ USB data transfer cables
- USB ⇒ USB null-modem cables

GENERAL DESCRIPTION

The FT8U245AM provides an easy cost-effective method of transferring data to / from a peripheral and a host P.C. at up to 8 Million bits (1 Megabyte) per second. It’s simple FIFO-like design makes it easy to interface to any CPU (MCU) either by mapping the device into the Memory / IO map of the CPU, using DMA or controlling the device via IO ports.

To send data from the peripheral to the host P.C. simply write the byte wide data into the device when the transmitter empty status bit is not active. If the (384 byte) transmit buffer fills up, the device de-asserts transmit empty in order to stop further data being written to the device until some of the FIFO data has been transferred over USB.

When the host P.C. sends data to the peripheral over USB, the device will assert the receiver full status bit to let the peripheral know that data is available. The peripheral then reads the data until the receiver full status bit goes inactive, indicating no more data is available to read.

By using FTDI’s virtual COM Port drivers, the peripheral looks like a standard COM Port to the application software. Commands to set the baud rate are ignored – the device always transfers data at it’s fastest rate regardless of the application’s baud rate setting.
Figure 1 – FT8U245AM Block Diagram (Simplified)

Figure 2 – FT8U245AM I.C. Pinout

OBSOLETE
FT8U245AM - FUNCTIONAL BLOCK DESCRIPTION

- **3.3V LDO Regulator**
  The 3.3V LDO Regulator generates the 3.3 volt reference voltage for driving the USB transceiver cell output buffers. It requires an external decoupling capacitor to be attached to the 3V3OUT regulator output pin.

- **USB Transceiver**
  The USB Transceiver Cell provides the USB 1.1 full-speed physical interface to the USB cable. The output drivers provide 3.3 volt level slew rate control signalling, whilst a differential receiver and two single ended receivers provide USB data in, SEO and USB Reset condition detection.

- **USB DPLL**
  The USB DPLL cell locks on to the incoming NRZI USB data and provides separate recovered clock and data signals to the SIE block.

- **6MHz Oscillator**
  The 6MHz Oscillator cell generates a 6MHz reference clock input to the X8 Clock multiplier from an external 6MHz crystal or ceramic resonator.

- **X8 Clock Multiplier**
  The X8 Clock Multiplier takes the 6MHz input from the Oscillator cell and generates a 12MHz reference clock for the SIE, USB Protocol Engine and UART FIFO controller blocks. It also generates a 48MHz reference clock for the USB DPPL and the Baud Rate Generator blocks.

- **Serial Interface Engine (SIE)**
  The Serial Interface Engine (SIE) block performs the Parallel to Serial and Serial to Parallel conversion of the USB data. In accordance to the USB 1.1 specification, it performs bit stuffing / un-stuffing and CRC5 / CRC16 generation / checking on the USB data stream.

- **USB Protocol Engine**
  The USB Protocol Engine manages the data stream from the device USB control endpoint. It handles the low level USB protocol (Chapter 9) requests generated by the USB host controller and the commands for controlling the functional parameters of the UART.

- **Fifo Receive Buffer (128 bytes)**
  Data sent from the USB Host to the FIFO via the USB data out endpoint is stored in the FIFO Receive Buffer and is removed from the buffer by reading the FIFO contents using RD#.
• **FIFO Transmit Buffer (384 bytes)**
  Data written into the FIFO using WR# is stored in the FIFO Transmit Buffer. The Host removes Data from the FIFO Transmit Data by sending a USB request for data from the device data in endpoint.

• **FIFO Controller**
  The FIFO Controller handles the transfer of data between the external FIFO interface pins and the FIFO Transmit and Receive buffers.

• **EEPROM Interface**
  The FT8U245AM uses an external 93C46 EEPROM to customise the USB VID, PID, Serial Number and Strings of the FT8U245AM for OEM applications. The FT8U245 Virtual Com Port Drivers rely on a unique device serial number for to bind a unique virtual COM port to each individual device.
## Table 1 - FT8U245AM - PINOUT DESCRIPTION

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Signal</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>USBDP</td>
<td>I/O</td>
<td>USB Data Signal Plus – Requires 1.5k pull-up to 3V3OUT</td>
</tr>
<tr>
<td>8</td>
<td>USBDM</td>
<td>I/O</td>
<td>USB Data Signal Minus</td>
</tr>
<tr>
<td>6</td>
<td>3V3OUT</td>
<td>OUT</td>
<td>3.3 volt Output from integrated regulator</td>
</tr>
<tr>
<td>27</td>
<td>XTIN</td>
<td>IN</td>
<td>Input to 6MHz Crystal Oscillator Cell</td>
</tr>
<tr>
<td>28</td>
<td>XOUT</td>
<td>OUT</td>
<td>Output from 6MHz Crystal Oscillator Cell</td>
</tr>
<tr>
<td>31</td>
<td>RCCLK</td>
<td>I/O</td>
<td>RC timer – used to guarantee clock stability on exiting sleep mode. Clamped low during reset or sleep condition.</td>
</tr>
<tr>
<td>4</td>
<td>RESET#</td>
<td>IN</td>
<td>Resets entire device using external RC network</td>
</tr>
<tr>
<td>32</td>
<td>EECS</td>
<td>I/O</td>
<td>Optional EEPROM – Chip Select</td>
</tr>
<tr>
<td>1</td>
<td>EESK</td>
<td>I/O</td>
<td>Optional EEPROM – Clock</td>
</tr>
<tr>
<td>2</td>
<td>EEDATA</td>
<td>I/O</td>
<td>Optional EEPROM – Data I/O</td>
</tr>
<tr>
<td>5</td>
<td>TEST</td>
<td>IN</td>
<td>Puts device in i.c. test mode – must be tied to GND</td>
</tr>
<tr>
<td>25</td>
<td>D0</td>
<td>I/O</td>
<td>Bi-directional Data Bus Bit # 0</td>
</tr>
<tr>
<td>24</td>
<td>D1</td>
<td>I/O</td>
<td>Bi-directional Data Bus Bit # 1</td>
</tr>
<tr>
<td>23</td>
<td>D2</td>
<td>I/O</td>
<td>Bi-directional Data Bus Bit # 2</td>
</tr>
<tr>
<td>22</td>
<td>D3</td>
<td>I/O</td>
<td>Bi-directional Data Bus Bit # 3</td>
</tr>
<tr>
<td>21</td>
<td>D4</td>
<td>I/O</td>
<td>Bi-directional Data Bus Bit #</td>
</tr>
<tr>
<td>20</td>
<td>D5</td>
<td>I/O</td>
<td>Bi-directional Data Bus Bit #</td>
</tr>
<tr>
<td>19</td>
<td>D6</td>
<td>I/O</td>
<td>Bi-directional Data Bus Bit #</td>
</tr>
<tr>
<td>18</td>
<td>D7</td>
<td>I/O</td>
<td>Bi-directional Data Bus Bit #</td>
</tr>
<tr>
<td>16</td>
<td>RD#</td>
<td>IN</td>
<td>Enables Current FIFO Data Byte on D0..D7.when low. Fetched the next FIFO Data Byte ( if available ) from the Receive FIFO Buffer when RD# goes from low to high.</td>
</tr>
<tr>
<td>15</td>
<td>WR</td>
<td>IN</td>
<td>Writes the Data Byte on the D0..D7 into the Transmit FIFO Buffer when WR goes from high to low.</td>
</tr>
<tr>
<td>14</td>
<td>TXE#</td>
<td>OUT</td>
<td>When high, do not write data into the FIFO. When low, data can be written into the FIFO by strobing WR high then low.</td>
</tr>
<tr>
<td>12</td>
<td>RXF#</td>
<td>OUT</td>
<td>When high, do not read data from the FIFO. When low, there is data available in the FIFO which can be read by strobing RD# low then high again.</td>
</tr>
<tr>
<td>11</td>
<td>EEREQ#</td>
<td>IN</td>
<td>Requests the EEPROM contents to be accessed via the Data Bus.</td>
</tr>
<tr>
<td>10</td>
<td>EEGNT#</td>
<td>OUT</td>
<td>When low, allows the EEPROM contents to be accessed via the Data Bus.</td>
</tr>
<tr>
<td>3,13,26</td>
<td>VCC</td>
<td>PWR</td>
<td>Device - +4.4 volt to +5.25 volt Power Supply Pins</td>
</tr>
<tr>
<td>9,17</td>
<td>GND</td>
<td>PWR</td>
<td>Device – Ground Supply Pins</td>
</tr>
<tr>
<td>30</td>
<td>AVCC</td>
<td>PWR</td>
<td>Device - Analog Power Supply for the internal x8 clock multiplier</td>
</tr>
<tr>
<td>29</td>
<td>AGND</td>
<td>PWR</td>
<td>Device - Analog Ground Supply for the internal x8 clock multiplier</td>
</tr>
</tbody>
</table>
FT8U245AM TIMING DIAGRAM – FIFO READ CYCLE

<table>
<thead>
<tr>
<th>Time</th>
<th>Description</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>RD Active Pulse Width</td>
<td>50</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>T2</td>
<td>RD to RD Pre-Charge Time</td>
<td>50</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>T3</td>
<td>RD Active to Valid Data</td>
<td></td>
<td>30</td>
<td>ns</td>
</tr>
<tr>
<td>T4</td>
<td>Valid Data Hold Time from RD inactive</td>
<td>10</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>T5</td>
<td>RD Inactive to RXF#</td>
<td>5</td>
<td>25</td>
<td>ns</td>
</tr>
<tr>
<td>T6</td>
<td>RXF inactive after RD cycle</td>
<td>80</td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>
FT8U245AM TIMING DIAGRAM – FIFO WRITE CYCLE

<table>
<thead>
<tr>
<th>Time</th>
<th>Description</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T7</td>
<td>WR Active Pulse Width</td>
<td>50</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>T8</td>
<td>WR to WR Pre-Charge Time</td>
<td>50</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>T9</td>
<td>Data Setup Time before WR inactive</td>
<td></td>
<td>20</td>
<td>ns</td>
</tr>
<tr>
<td>T10</td>
<td>Data Hold Time from WR inactive</td>
<td>10</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>T11</td>
<td>WR Inactive to TXE#</td>
<td>5</td>
<td>25</td>
<td>ns</td>
</tr>
<tr>
<td>T12</td>
<td>TXE inactive after RD cycle</td>
<td></td>
<td>80</td>
<td>ns</td>
</tr>
</tbody>
</table>
Figure 3. FT8U245AM - PACKAGE DESCRIPTION – QFP 7mm x 7mm

All dimensions in millimetres
**Absolute Maximum Ratings**

Storage Temperature .............................................................. -65°C to + 150°C  
Ambient Temperature (Power Applied) ..................................... 0°C to + 70°C  
VCC Supply Voltage ............................................................. -0.5v to +6.00v  
DC Input Voltage - Inputs ..................................................... -0.5v to VCC + 0.5v  
DC Input Voltage - High Impedance Bidirectionals ..................... -0.5v to VCC + 0.5v  
DC Output Current – Outputs .................................................. 24mA  
DC Output Current – Low Impedance Bidirectionals ..................... 24mA  
Power Dissipation ............................................................... 500mW

**DC Characteristics (Ambient Temperature = 0 .. 70 Degrees C)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC  Operating Supply Voltage</td>
<td>4.4</td>
<td>5.25</td>
<td>v</td>
<td></td>
</tr>
<tr>
<td>Icc1 Operating Supply Current</td>
<td>50</td>
<td>mA</td>
<td>Normal Operation</td>
<td></td>
</tr>
<tr>
<td>Icc2 Operating Supply Current</td>
<td>250</td>
<td>uA</td>
<td>USB Suspend</td>
<td></td>
</tr>
<tr>
<td>Ioh1 Digital IO Pins Source Current</td>
<td>4</td>
<td>mA</td>
<td>Voh = VCC – 0.5v</td>
<td></td>
</tr>
<tr>
<td>Iol1 Digital IO Pins Sink Current</td>
<td>4</td>
<td>mA</td>
<td>Vol = + 0.5v</td>
<td></td>
</tr>
<tr>
<td>Voh1 Input Voltage Threshold (Low)</td>
<td>0.3</td>
<td>v</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vol1 Input Voltage Threshold (High)</td>
<td>2.7</td>
<td>v</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VDif USB Differential Input Sensitivity</td>
<td>0.2</td>
<td>v</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCom USB Differential Common Mode</td>
<td>0.8</td>
<td>2.5</td>
<td>v</td>
<td></td>
</tr>
<tr>
<td>URxt USB Single Ended Rx Threshold</td>
<td>0.8</td>
<td>2.0</td>
<td>v</td>
<td></td>
</tr>
<tr>
<td>UVh USB IO Pins Static Output (Low)</td>
<td>0.3v</td>
<td>RI = 1.5k to 3.6v</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UVl USB IO Pins Static Output (High)</td>
<td>2.8</td>
<td>RI = 15k to GND</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Agents and Sales Representatives

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Appendix A

USB Device Descriptors
USB Device Descriptors

Note: E - replaced by E2Rom Value, C - modified by configuration option

LABEL : Device_Des;
{*
    device descriptor *
}*
LABEL : Device_Len;{length of this descriptor in bytes}*
0010 12 Val : Device_Len;{length of this descriptor in bytes}*
0011 01 Val : $01;{Device descriptor type}*
0012 10 01 Val : $10,$01;{USB Spec rev 1.10}*
0014 00 Val : $00;{Device class ?}*
0015 00 Val : $00;{Device subclass ?}*
0016 00 Val : $00;{Device protocol ?}*
0017 08 Val : Max_Length;{maximum packet size}*
LABEL : Device_Des_Vendor;*
E 0018 03 04 Val : $03,$04;{Vendor ID FTDI}*
E 001A 01 60 Val : $01,$60;{product number 6001}*
LABEL : Device_Des_Vendor_End;*
E 001C 00 02 Val : $00,$02;{device release number 02.00}*
001E 01 Val : $01;{index of string descriptor describing manufacturer}*
001F 02 Val : $02;{index of string descriptor describing product}*
0020 03 Val : $03;{index of string descriptor describing serial number}*
0021 01 Val : $01;{number of possible configurations}*
{*
    end of device descriptor *
}*
LABEL : Device_Des_End;*
LABEL : Config_Des;*
{*
    configuration descriptor *
}*
0022 09 Val : $09;{length of this descriptor in bytes}*
0023 02 Val : $02;{Configuration descriptor}*
0024 20 00 Val : Config_Len,$00;{length of data returned for all things}*
0026 01 Val : $01;{number of interfaces supported by this configuration}*
0027 01 Val : $01;{configuration value}*
0028 00 Val : $00;{index of string descriptor describing this configuration}*
E 0029 80 Val : 10000000b;{configured as bus powered and not remote wakeup}*
E 002A 2D Val : 45;{maximum power in 2 mA ie 90mA for now}*
{*
    end of configuration descriptor *
}*
LABEL : Interface_Des;*
{*
    interface descriptor *
}*
002B 09 Val : $09;{length of this descriptor in bytes}*
002C 04 Val : $04;{Interface descriptor}*
002D 00 Val : $00;{interface number}*
002E 00 Val : $00;{alternate setting}*
002F 02 Val : $02;{number of endpoints excluding 0 = 1}*
0030 FF Val : $ff;{class code}*
0031 FF Val : $ff;{subclass}*
0032 FF Val : $ff;{protocol code}*
0033 02 Val : $02;{index of string descriptor describing this interface}*
{*
    end of interface descriptor *
}*
LABEL : Interface_Des_End;*
LABEL : Endpoint_Des;*
LABEL : Endpoint3_Des_End;*
0034 07 Val : $07;{length of this descriptor in bytes}*
0035 05 Val : $05;{End point descriptor}*
0036 81 Val : 10000001b;{in endpoint at address 1}*
0037 02 Val : 00000010b;{attribute as bulk}*
0038 40 00 Val : 64,$00;{maximum packet size}*
003A 00 Val : $00;{interval for polling endpoint for data transfers}*

OBSOLETE
LABEL : Endpoint3_Des; {* end point descriptor *}
  003B 07      Val : $07;{length of this descriptor in bytes}
  003C 05      Val : $05;{End point descriptor}
  003D 02      Val : 00000010b;{out endpoint at address 2}
  003E 02      Val : 00000010b;{attribute as bulk}
  003F 40 00   Val : 64,$00;{maximum packet size}
  0041 00      Val : $00;{interval for polling endpoint for data transfers}

LABEL : Endpoint_Des_End;
LABEL : Config_Des_End;

LABEL : Str0_Des;
  E 0042 04      Val : Str0_Len; {length of string descriptor}
  E 0043 03      Val : $03; {type string}
  E 0044 09 04   Val : $09,$04; {language ID 0009 English}
LABEL : Str0_Des_End;

LABEL : Str1_Des;
  E 0046 0A      Val : Str1_Len; {length of string descriptor}
  E 0047 03      Val : $03; {type string}
  E 0048 46 00   Val : 'F',$00;
  E 0049 54 00   Val : 'T',$00;
  E 004A 64 00   Val : 'D',$00;
  E 004B 49 00   Val : 'I',$00;
LABEL : Str1_Des_End;

LABEL : Str2_Des;
  E 0050 1E      Val : Str2_Len; {length of string descriptor}
  E 0051 03      Val : $03; {type string}
  E 0052 31 00   Val : '1',00;
  E 0053 32 00   Val : '2',00;
  E 0054 33 00   Val : '3',00;
  E 0055 34 00   Val : '4',00;
  E 0056 35 00   Val : '5',00;
  E 0057 36 00   Val : '6',00;
  E 0058 37 00   Val : '7',00;
  E 0059 38 00   Val : '8',00;
LABEL : Str2_Des_End;

LABEL : Str3_Des;
  E 0062 12      Val : Str3_Len; {serial number string}
  E 0063 03      Val : $03; {type string}
  E 0064 31 00   Val : '1',00;
  E 0065 32 00   Val : '2',00;
  E 0066 33 00   Val : '3',00;
  E 0067 34 00   Val : '4',00;
  E 0068 35 00   Val : '5',00;
  E 0069 36 00   Val : '6',00;
  E 006A 37 00   Val : '7',00;
  E 006B 38 00   Val : '8',00;
LABEL : Str3_Des_End;
Appendix B

EEPROM Data Structure
E2Rom Data example

0000 00 00 Val : $00,$00; (Configuration value)
0002 03 04 Val : $03,$04; (Vendor ID FTDI)
0004 60 00 Val : $01,$60; (product number 6001)
0006 00 02 Val : $00,$02; (device release number)
0008 A0 Val : 10100000b; (config descriptor value bus powered and remote wakeup)
0009 2D Val : 45; (max power = value * 2 mA)
000A 00 00 Val : $00,$00; (reserved)
000C 00 00 Val : $00,$00; (reserved)
000E 94 Val : PTR_ManStringDes;
000F 0C Val : ManStringDes_Len; (length of string descriptor)
0010 A0 Val : PTR_ProdStringDes;
0011 34 Val : ProdStringDes_Len; (length of string descriptor)
0012 D4 Val : PTR_SerStringDes;
0013 12 Val : SerStringDes_Len;

LABEL : ManStringDes;
0014 0C Val : ManStringDes_Len; (length of string descriptor)
0015 03 Val : $03; (type string)
0016 41 00 Val : 'A', $00;
0018 66 00 Val : 'n', $00;
001A 66 00 Val : 'd', $00;
001C 79 00 Val : 'y', $00;
001E 73 00 Val : 's', $00;
LABEL : ManStringDes_End;

LABEL : ProdStringDes;
0020 34 Val : ProdStringDes_Len; (length of string descriptor)
0021 03 Val : $03; (type string)
0022 57 00 Val : 'W', $00;
0024 6F 00 Val : 'o', $00;
0026 6E 00 Val : 'n', $00;
0028 64 00 Val : 'd', $00;
002A 65 00 Val : 'e', $00;
002C 72 00 Val : 'r', $00;
002E 66 00 Val : 'f', $00;
0030 75 00 Val : 'u', $00;
0032 6C 00 Val : 'l', $00;
0034 6C 00 Val : 'l', $00;
0036 20 00 Val : ' ', $00;
0038 55 00 Val : 'U', $00;
003A 53 00 Val : 'S', $00;
003C 42 00 Val : 'B', $00;
003E 20 00 Val : ' ', $00;
0040 3C 00 Val : '<', $00;
0042 2D 00 Val : '-', $00;
0044 3E 00 Val : '>', $00;
0046 20 00 Val : ' ', $00;
0048 53 00 Val : '3', $00;
004A 65 00 Val : '5', $00;
004C 72 00 Val : '2', $00;
004E 69 00 Val : '1', $00;
0050 61 00 Val : 'a', $00;
0052 6C 00 Val : 'l', $00;
LABEL : ProdStringDes_End;

LABEL : SerStringDes;
0054 12 Val : SerStringDes_Len;
0055 03 Val : $03; (type string)
0056 32 00 Val : '2', $00;
0058 32 00 Val : '2', $00;
005A 33 00 Val : '3', $00;
005C 34 00 Val : '4', $00;
005E 35 00 Val : '5', $00;
0060 36 00 Val : '6', $00;
0062 37 00 Val : '7', $00;
0064 38 00 Val : '8', $00;
LABEL : SerStringDes_End;

0066 00 00 Val : $00,$00; (reserved for Checksum)