**Features**

**Universal Serial Bus (USB)**
- Supports Full-Speed USB (12 Mb/s)
- Implements USB Protocol Composite Device:
  - Communication Device Class (CDC) for communications and configuration
  - Human Interface Device (HID) for I/O control
- 128-Byte Buffer to Handle Data Throughput at any UART Baud Rate:
  - 64-byte transmit
  - 64-byte receive
- Fully Configurable VID and PID Assignments and String Descriptors
- Bus-Powered or Self-Powered
- USB 2.0 Compliant: TID 40001150

**USB Driver and Software Support**
- Uses Standard Windows® Drivers for Virtual Com Port (VCP): Windows XP (SP2 or later), Windows Vista, Windows 7, Windows 8, Windows 8.1 and Windows 10
- Configuration Utility for Initial Configuration

**Universal Asynchronous Receiver/Transmitter (UART)**
- Responds to SET_LINE_CODING Commands to Dynamically Change Baud Rates
- Supports Baud Rates: 300-1000k
- Hardware Flow Control
- UART Signal Polarity Option

**General Purpose Input/Output (GPIO) Pins**
- Eight General Purpose I/O pins

**EEPROM**
- 256 Bytes of User EEPROM

**Other**
- USB Activity LED Outputs (TxLED and RxLED)
- SSPND Output Pin
- USBCFG Output Pin (indicates when the enumeration is completed)
- Operating Voltage: 3.0V to 5.5V
- Oscillator Input: 12 MHz
- Electrostatic Discharge (ESD) Protection: >4 kV Human Body Model (HBM)
- Industrial (I) Operating Temperature: -40°C to +85°C

**Package Types**

The device is offered in the following packages:
- 20-lead VQFN (5x5 mm)
- 20-lead SOIC
- 20-lead SSOP

*Includes Exposed Thermal Pad (EP); see Table 1-1.*
1.0 FUNCTIONAL DESCRIPTION

The MCP2200 is a USB-to-UART serial converter which enables USB connectivity in applications that have a UART interface. The device reduces external components by integrating the USB termination resistors. The MCP2200 also has 256 bytes of integrated user EEPROM.

The MCP2200 has eight general purpose input/output pins. Four pins have alternate functions to indicate USB and communication status. See Table 1-1 and Section 1.6 “GPIO Module” for details about the pin functions.

### TABLE 1-1: PINOUT DESCRIPTION

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>VQFN</th>
<th>SSOP, SOIC</th>
<th>Pin Type</th>
<th>Standard Function</th>
<th>Alternate Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP0/SSPND</td>
<td>13</td>
<td>16</td>
<td>I/O</td>
<td>General purpose I/O</td>
<td>USB suspend status pin (refer to Section 1.6.1.1 “SSPND Pin Function”)</td>
</tr>
<tr>
<td>GP1/USB-CFG</td>
<td>12</td>
<td>15</td>
<td>I/O</td>
<td>General purpose I/O</td>
<td>USB configuration status pin (refer to Section 1.6.1.2 “USBCFG Pin Function”)</td>
</tr>
<tr>
<td>GP2</td>
<td>11</td>
<td>14</td>
<td>I/O</td>
<td>General purpose I/O</td>
<td></td>
</tr>
<tr>
<td>GP3</td>
<td>6</td>
<td>9</td>
<td>I/O</td>
<td>General purpose I/O</td>
<td></td>
</tr>
<tr>
<td>GP4</td>
<td>5</td>
<td>8</td>
<td>I/O</td>
<td>General purpose I/O</td>
<td></td>
</tr>
<tr>
<td>GP5</td>
<td>4</td>
<td>7</td>
<td>I/O</td>
<td>General purpose I/O</td>
<td></td>
</tr>
<tr>
<td>GP6/RxLED</td>
<td>3</td>
<td>6</td>
<td>I/O</td>
<td>General purpose I/O</td>
<td>USB receive activity LED output (refer to Section 1.6.1.3 “RxLED Pin Function (IN Message)”)</td>
</tr>
<tr>
<td>GP7/TxLED</td>
<td>2</td>
<td>5</td>
<td>I/O</td>
<td>General purpose I/O</td>
<td>USB transmit activity LED output (refer to Section 1.6.1.4 “TxLED Pin Function (OUT Message)”)</td>
</tr>
<tr>
<td>CTS</td>
<td>10</td>
<td>13</td>
<td>I</td>
<td>Hardware flow control &quot;Clear to Send&quot; input signal</td>
<td></td>
</tr>
<tr>
<td>RTS</td>
<td>8</td>
<td>11</td>
<td>O</td>
<td>Hardware flow control &quot;Request to Send&quot; output signal</td>
<td></td>
</tr>
<tr>
<td>Rx</td>
<td>9</td>
<td>12</td>
<td>I</td>
<td>USART RX input</td>
<td></td>
</tr>
<tr>
<td>Tx</td>
<td>7</td>
<td>10</td>
<td>O</td>
<td>USART TX output</td>
<td></td>
</tr>
<tr>
<td>RST</td>
<td>1</td>
<td>4</td>
<td>I</td>
<td>Reset input must be externally biased</td>
<td></td>
</tr>
<tr>
<td>VDD</td>
<td>18</td>
<td>1</td>
<td>P</td>
<td>Power</td>
<td></td>
</tr>
<tr>
<td>VSS</td>
<td>17</td>
<td>20</td>
<td>P</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>OSC1</td>
<td>19</td>
<td>2</td>
<td>I</td>
<td>Oscillator input</td>
<td></td>
</tr>
<tr>
<td>OSC2</td>
<td>20</td>
<td>3</td>
<td>O</td>
<td>Oscillator output</td>
<td></td>
</tr>
<tr>
<td>D+</td>
<td>16</td>
<td>19</td>
<td>I/O</td>
<td>USB D+</td>
<td></td>
</tr>
<tr>
<td>D-</td>
<td>15</td>
<td>18</td>
<td>I/O</td>
<td>USB D-</td>
<td></td>
</tr>
<tr>
<td>Vusb</td>
<td>14</td>
<td>17</td>
<td>P</td>
<td>USB power pin (internally connected to 3.3V). Should be locally bypassed with a high-quality ceramic capacitor.</td>
<td></td>
</tr>
</tbody>
</table>
1.1 Supported Operating Systems

Windows XP (SP2 and later), Windows Vista, Windows 7, Windows 8, Windows 8.1 and Windows 10 operating systems are supported.

1.1.1 ENUMERATION

The MCP2200 will enumerate as a USB device after Power-on Reset (POR). The device enumerates as both a Human Interface Device (HID) for I/O control, and a Virtual Com Port (VCP).

1.1.1.1 Human Interface Device (HID)

The MCP2200 enumerates as an HID, so the device can be configured and the I/O can be controlled. A DLL that facilitates I/O control through a custom interface is supplied by Microchip.

1.1.1.2 Virtual Com Port (VCP)

The VCP enumeration implements the USB-to-UART data translation.

1.2 Control Module

The control module is the heart of the MCP2200. All other modules are tied together and controlled via the control module. The control module manages the data transfers between the USB and the UART, as well as the command requests generated by the USB host controller and the commands for controlling the function of the UART and I/O.

1.2.1 SERIAL INTERFACE

The control module interfaces to the UART and USB modules.

1.2.2 INTERFACING TO THE DEVICE

The MCP2200 can be accessed for reading and writing via USB host commands. The device cannot be accessed and controlled via the UART interface.

1.3 UART Interface

The MCP2200 UART interface consists of the Tx and Rx data signals and the RTS/CTS flow control pins.

The UART is configurable for several baud rates. The available baud rates are listed in Table 1-3.

1.3.1 INITIAL CONFIGURATION

The default UART configuration is 19200, 8, N, 1. The default start-up baud rate can be changed using the Microchip-supplied configuration PC tool.

Alternatively, a custom configuration tool can be created using the Microchip-supplied DLL to set the baud rate as well as other parameters. See Section 2.0 “Configuration” for details.

**TABLE 1-2: UART CONFIGURATIONS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Baud Rates</td>
<td>See Table 1-3</td>
</tr>
<tr>
<td>Data Bits</td>
<td>8</td>
</tr>
<tr>
<td>Parity</td>
<td>N</td>
</tr>
<tr>
<td>Stop Bits</td>
<td>1</td>
</tr>
</tbody>
</table>

1.3.2 GET/SET LINE CODING

The `GET_LINE_CODING` and `SET_LINE_CODING` commands are used to read and set the UART parameters while in operation. For example, HyperTerminal sends the `SET_LINE_COMMAND` when connecting to the port. The MCP2200 responds by setting the baud rate only. The other parameters (data bits, parity, stop bits) remain unchanged.

1.3.2.1 Rounding Errors

The primary baud rate setting (with the rounding errors) is shown in Table 1-3. If baud rates other than the ones shown in the table are used, the error percentage can be calculated using Equation 1-1 to find the actual baud rate.

**TABLE 1-3: UART PRIMARY BAUD RATES**

<table>
<thead>
<tr>
<th>Desired Rate</th>
<th>Actual Rate</th>
<th>% Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>300</td>
<td>0.00%</td>
</tr>
<tr>
<td>1200</td>
<td>1200</td>
<td>0.00%</td>
</tr>
<tr>
<td>2400</td>
<td>2400</td>
<td>0.00%</td>
</tr>
<tr>
<td>4800</td>
<td>4800</td>
<td>0.00%</td>
</tr>
<tr>
<td>9600</td>
<td>9600</td>
<td>0.00%</td>
</tr>
<tr>
<td>19200</td>
<td>19200</td>
<td>0.00%</td>
</tr>
<tr>
<td>38400</td>
<td>38339</td>
<td>0.16%</td>
</tr>
<tr>
<td>57600</td>
<td>57692</td>
<td>0.16%</td>
</tr>
<tr>
<td>115200</td>
<td>115385</td>
<td>0.16%</td>
</tr>
<tr>
<td>230400</td>
<td>230769</td>
<td>0.16%</td>
</tr>
<tr>
<td>460800</td>
<td>461538</td>
<td>0.16%</td>
</tr>
<tr>
<td>921600</td>
<td>923077</td>
<td>0.16%</td>
</tr>
</tbody>
</table>
1.3.3 CUSTOM BAUD RATES

Custom baud rates are configured by sending the `SET_LINE_CODING` USB command, or by using the DLL. See Section 2.0 “Configuration” for more information.

1.3.4 HARDWARE FLOW CONTROL

Hardware flow control uses the RTS and CTS pins as a handshake between two devices. The RTS pin of one device is typically connected to the CTS of the other device.

RTS is an active-low output that notifies the other device when it is ready to receive data by driving the pin low. The MCP2200 trip point for deasserting RTS (high) is 63 characters. This is one character short of “buffer full”.

CTS is an active-low input that notifies the MCP2200 when it is ready to send data. The MCP2200 will check CTS just before loading and sending UART data. If the pin is asserted during a transfer, the transfer will continue. Refer to Figure 1-1.

1.3.4.1 Flow Control Disabled

The buffer pointer does not increment (or reset to zero) if the buffer is full. Therefore, if hardware flow control is not enabled and an overflow occurs (i.e., 65 unprocessed characters received), the new data overwrites the last position in the buffer.

1.4 USB Protocol Controller

The USB controller in the MCP2200 is full-speed USB 2.0 compliant.

- Composite device (CDC + HID):
  - CDC: USB-to-UART communications
  - HID: I/O control, EEPROM access and initial configuration
- 128-byte buffer to handle data throughput at any UART baud rate:
  - 64-byte transmit
  - 64-byte receive
- Fully configurable VID and PID assignments and descriptors (stored on-chip)
- Bus-powered or self-powered

1.4.1 DESCRIPTORS

During configuration, the supplied PC interface stores the descriptors in the MCP2200.

1.4.2 SUSPEND AND RESUME

The USB Suspend and Resume signals are supported for power management of the MCP2200. The device enters Suspend mode when “suspend signaling” is detected on the bus.

The MCP2200 exits Suspend mode when any of the following events occur:

1. “Resume signaling” is detected or generated
2. A USB “Reset” signal is detected
3. A device reset occurs

1.5 USB Transceiver

The MCP2200 has a built-in, full-speed USB 2.0 transceiver internally connected to the USB module.

The USB transceiver obtains power from the VUSB pin, which is internally connected to the 3.3V regulator. The best electrical signal quality is obtained when VUSB is locally bypassed with a high-quality ceramic capacitor.

1.5.1 INTERNAL PULL-UP RESISTORS

The MCP2200 devices have built-in pull-up resistors designed to meet the requirements for full-speed USB.

1.5.2 MCP2200 POWER OPTIONS

The following are the main power options for the MCP2200:

- USB Bus-Powered (5V)
- 3.3V Self-Powered

---

EQUATION 1-1: SOLVING FOR ACTUAL BAUD RATE

ActualRate = \frac{12\text{ MHz}}{\text{int}(x)}

Where:

\[ x = \frac{12\text{ MHz}}{\text{Desired Baud}} \]
1.5.2.1 Internal Power Supply Details

MCP2200 offers various options for power supply. To meet the required USB signaling levels, the MCP2200 device incorporates an internal LDO used solely by the USB transceiver in order to present the correct D+/D- voltage levels.

Figure 1-2 shows the internal connections of the USB transceiver LDO in relation to the VDD power supply rail. The output of the USB transceiver LDO is tied to the VUSB line. A capacitor connected to the VUSB pin is required if the USB transceiver LDO provides the 3.3V supply to the transceiver.

**FIGURE 1-2: MCP2200 INTERNAL POWER SUPPLY DETAILS**

The provided VDD voltage has a direct influence on the voltage levels present on the GPIO pins (Rx/Tx and RTS/CTS). When VDD is 5V, all of these pins will have a logical ‘1’ around 5V with the variations specified in Section 3.1 “DC Characteristics”.

For applications that require a 3.3V logical ‘1’ level, VDD must be connected to a power supply providing 3.3V voltage. In this case, the internal USB transceiver LDO cannot provide the required 3.3V of power. It is necessary to also connect the VUSB pin to the 3.3V power supply rail. This way, the USB transceiver is powered-up directly from the 3.3V power supply.

1.5.2.2 USB Bus-Powered (5V)

In Bus Power Only mode, all power for the application is drawn from the USB (Figure 1-3). This is effectively the simplest power method for the device.

**FIGURE 1-3: BUS POWER ONLY**

In order to meet the inrush current requirements of the USB 2.0 specifications, the total effective capacitance appearing across VBUS and ground must be no more than 10 µF. If it is not more than 10 µF, some kind of inrush current limiting is required. For more details on inrush current limiting, consider the latest version of the “Universal Serial Bus Specification”.

According to the USB 2.0 specification, all USB devices must also support a low-power Suspend mode. In the USB Suspend mode, devices must consume no more than 500 µA (or 2.5 mA for high-powered devices that are remote wake-up capable) from the 5V Vbus line of the USB cable.

The host signals the USB device to enter Suspend mode by stopping all USB traffic to that device for more than 3 ms.

The USB bus provides a 5V voltage. However, the USB transceiver requires 3.3V for the signaling (on the D+ and D- lines).

During USB Suspend mode, the D+ or D- pull-up resistor must remain active, which will consume some of the allowed suspended current budget (500 µA/2.5 mA). The VUSB pin is required to have an external bypass capacitor. It is recommended that the capacitor be a ceramic capacitor between 0.22 µF. and 0.47 µF.

Figure 1-4 shows a circuit where MCP2200’s internal LDO is used to provide 3.3V to the USB transceiver. The voltage on the Vdd affects the voltage levels onto the GPIO pins (Rx/Tx and RTS/CTS). With Vdd at 5V, these pins will have a logic ‘1’ of 5V with the variations specified in Section 3.1 “DC Characteristics”.

**FIGURE 1-4: CIRCUIT DIAGRAM**
1.5.2.3 3.3V Self-Powered

Typically, many embedded applications are using 3.3V power supplies. When such an option is available in the target system, MCP2200 can be powered up from the existing 3.3V power supply rail. The typical connections for the MCP2200 are shown in Figure 1-5.

In this example, the MCP2200 has both VDD and VUSB lines tied to the 3.3V rail. These tied connections disable the internal USB transceiver LDO of the MCP2200 to regulate the power supply on VUSB pin. Another consequence is that the ‘1’ logical level on the GPIO pins will be at the 3.3V level, in accordance with the variations specified in Section 3.1 “DC Characteristics”.

1.6 GPIO Module

The GPIO Module is a standard 8-bit I/O port.

1.6.1 CONFIGURABLE PIN FUNCTIONS

The pins can be configured as:
- GPIO – individually configurable general purpose input or output
- SSPND – USB Suspend state
- USBCFG – indicates USB configuration status
- RxLED – indicates USB receive traffic
- TxLED – indicates USB transmit traffic

1.6.1.1 SSPND Pin Function

The SSPND pin (if enabled) reflects the USB state (Suspend/Resume). The pin is active-low when the Suspend state has been issued by the USB host. Likewise, the pin drives ‘high’ after the Resume state is achieved.

This pin allows the application to go into low power mode when USB communication is suspended, and switches to a full active state when USB activity is resumed.

1.6.1.2 USBCFG Pin Function

The USBCFG pin (if enabled) starts out ‘low’ during power-up or after Reset, and goes ‘high’ after the device successfully configures to the USB. The pin will go ‘low’ when in Suspend mode and ‘high’ when the USB resumes.
1.6.1.3 RxLED Pin Function (IN Message)
The 'Rx' in the pin name is in respect to the USB host. The RxLED pin is an indicator for USB ‘IN’ messages. This pin will either pulse low for a period of time (configurable for ~100 ms or ~200 ms), or toggle to the opposite state for every message received (IN message) by the USB host. This allows the application to count messages or provide a visual indication of USB traffic.

1.6.1.4 TxLED Pin Function (OUT Message)
The 'Tx' in the pin name is in respect to the USB host. The TxLED pin is an indicator for USB ‘OUT’ messages. This pin will either pulse low for a period of time (configurable for ~100 ms or ~200 ms), or toggle to the opposite state for every message transmitted (OUT message) by the USB host. This allows the application to count messages or provide a visual indication of USB traffic.

1.7 EEPROM Module
The EEPROM module is a 256-byte array of nonvolatile memory. The memory locations are accessed for read/write operations via USB host commands. Refer to Section 2.0 "Configuration" for details on accessing the EEPROM. The memory cells for data EEPROM are rated to endure thousands of erase/write cycles, up to 100K for EEPROM. Data retention without refresh is conservatively estimated to be greater than 40 years. The host should wait for the write cycle to complete and then verify the write by reading the byte(s).

1.8 RESET/POR
1.8.1 RESET PIN
The RST pin provides a method for triggering an external Reset of the device. A Reset is generated by holding the pin low. These devices have a noise filter in the Reset path which detects and ignores small pulses.

1.8.2 POWER-ON RESET (POR)
A POR pulse is generated on-chip whenever VDD rises above a certain threshold. This allows the device to start in the initialized state when VDD is adequate for operation. To take advantage of the POR circuitry, tie the RST pin through a resistor (1 kΩ to 10 kΩ) to VDD. This will eliminate external RC components usually needed to create a POR delay.

When the device starts normal operation (i.e., exits the Reset condition), device operating parameters (voltage, frequency, temperature, etc.) must be met to ensure operation. If these conditions are not achieved, the device must be held in Reset until the operating conditions are met.

1.9 Oscillator
The input clock must be 12 MHz to provide the proper frequency for the USB module. USB full speed is defined as 12 Mb/s. The clock input accuracy is ±0.25% (2,500 ppm maximum).
2.0 CONFIGURATION

The MCP2200 is configured by writing special commands using the HID interface. Configuration can be achieved using the configuration utility provided by Microchip. Alternatively, a custom utility can be developed by using the DLL available on the MCP2200 product page.

2.1 Configuration Utility

The configuration utility provided by Microchip allows the user to configure the MCP2200 to custom defaults. The configuration utility (shown in Figure 2-1) connects to the device’s HID interface, where all of the configurable features can be set.

2.2 Serial String

The MCP2200 is supplied from the factory with a serialized USB serial string.

<table>
<thead>
<tr>
<th>TABLE 2-1: CONFIGURATION DESCRIPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configuration Name</strong></td>
</tr>
<tr>
<td>Vendor ID (0x04D8)</td>
</tr>
<tr>
<td>Product ID (0x00DF)</td>
</tr>
<tr>
<td>Baud Rate</td>
</tr>
<tr>
<td>IO Config</td>
</tr>
<tr>
<td>IO Default</td>
</tr>
<tr>
<td>Tx/Rx LEDs</td>
</tr>
<tr>
<td>Hardware Flow Control</td>
</tr>
<tr>
<td>USBCFG Pin</td>
</tr>
<tr>
<td>Suspend Pin</td>
</tr>
<tr>
<td>Invert Sense</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Manufacturer String</td>
</tr>
<tr>
<td>Product String</td>
</tr>
</tbody>
</table>
FIGURE 2-1: CONFIGURATION UTILITY
2.3 Simple Configuration and I/O DLL

To help the user develop a custom configurator, Microchip provides a DLL that uses Microsoft®.NET Framework 3.5. There is documentation about drivers and utilities on the MCP2200 product page at www.microchip.com (in the Software section) with information on associating the DLL with a Visual C++ project.

Table 2-2 lists the functions provided by the DLL to allow the configuration of the device and control of the I/O.

### Table 2-2: Configuration Functions

<table>
<thead>
<tr>
<th>Category and Function Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initialization (Note 1)</strong></td>
<td><code>void InitMCP2200(VID, PID)</code></td>
</tr>
<tr>
<td><strong>Configuration (Note 2)</strong></td>
<td><code>bool ConfigureIO(mask)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool ConfigureIODefaultOutput(mask, defaultGpioOutputValue)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool fnRxLED (OFF/TOGGLE/BLINKSLOW/BLINKFAST)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool fnTxLED (OFF/TOGGLE/BLINKSLOW/BLINKFAST)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool fnHardwareFlowControl (ON/OFF)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool fnULoad(ON/OFF)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool fnSuspend (ON/OFF)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool ConfigureMCP2200(mask, baudrate, RxLedMode, TxLedMode, flowCtrl, ULoad, suspend)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool ConfigureIO(mask)</code></td>
</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
<td><code>String^ GetDeviceInfo(deviceIndex)</code></td>
</tr>
<tr>
<td></td>
<td><code>unsigned int GetNoOfDevices()</code></td>
</tr>
<tr>
<td></td>
<td><code>int GetSelectedDevice()</code></td>
</tr>
<tr>
<td></td>
<td><code>String^ GetSelectedDeviceInfo()</code></td>
</tr>
<tr>
<td></td>
<td><code>bool isConnected()</code></td>
</tr>
<tr>
<td></td>
<td><code>int SelectDevice(uiDeviceNo)</code></td>
</tr>
<tr>
<td></td>
<td><code>int ReadEEPROM(uiEEPAddress)</code></td>
</tr>
<tr>
<td></td>
<td><code>int WriteEEPROM(uiEEPAddress, ucValue)</code></td>
</tr>
<tr>
<td><strong>I/O Control</strong></td>
<td><code>bool ClearPin(pinnumber)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool SetPin(pinnumber)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool ReadPin(pinnumber, *pinvalue)</code></td>
</tr>
<tr>
<td></td>
<td><code>int ReadPinValue(pinnumber)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool ReadPort(*portValue)</code></td>
</tr>
<tr>
<td></td>
<td><code>int ReadPortValue()</code></td>
</tr>
<tr>
<td></td>
<td><code>bool WritePort(portValue)</code></td>
</tr>
<tr>
<td><strong>Summary</strong></td>
<td><code>bool SimpleIOClass::ClearPin(unsigned int pin)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool SimpleIOClass::ConfigureIO (unsigned char IOMap)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool SimpleIOClass::ConfigureIODefaultOutput(unsigned char ucIoMap, unsigned char ucDefValue, ucIoMap)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool SimpleIOClass::ConfigureMCP2200 (unsigned char IOMap, unsigned long BaudRateParam, unsigned int RxLEDMode, unsigned int TxLEDMode, bool FLOW, bool ULOAD, bool SSPND)</code></td>
</tr>
<tr>
<td></td>
<td><code>bool SimpleIOClass::fnHardwareFlowControl (unsigned int onOff)</code></td>
</tr>
</tbody>
</table>

**Note 1:** Prior to any DLL API usage, a call to the `InitMCP2200` function is needed. This function is the only initialization function in the presented DLL.

**Note 2:** The configuration only needs to be set a single time – it is stored in NVM.
### 2.3.1.1 ClearPin

**Function:**

`bool SimpleIOC::ClearPin(unsigned int pin)`

**Summary:** Clears the specified pin.

**Description:** Clears the specified pin to logic '0'.

**Precondition:** This pin must be previously configured as an output via a `ConfigureIO` or `ConfigureIoDefaultOutput` call.

**Parameters:**

- `pin` - The pin number to set (0-7).

**Returns:** This function returns True if the transmission is successful and returns False if the transmission fails.

**Remarks:** None

**EXAMPLE 2-1:**

```c++
if (SimpleIOC::ClearPin(2))
{
    lblStatusBar->Text = "Success";
}
else
    lblStatusBar->Text = "Invalid command " + SimpleIOC::LastError;
```
2.3.1.2 ConfigureIO

Function:
bool SimpleIOClass::ConfigureIO (unsigned char IOMap)

Summary: Configures the GPIO pins for Digital Input or Digital Output.
Description: GPIO Pins can be configured as Digital Input or Digital Output.
Precondition: VID and PID must be previously set via a call to InitMCP2200 (VID, PID).
Parameters:
IOMap - a byte that represents a bitmap of the GPIO configuration:
• a bit set to '1' will be a digital input
• a bit set to '0' will be a digital output
• MSB    –        –       –       –       –       –      LSB
  GP7  GP6  GP5  GP4  GP3  GP2  GP1  GP0
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: Error code is returned in LastError.

EXAMPLE 2-2:

```c
if (SimpleIOClass::ConfigureIO(0xA5) == SUCCESS)
    lblStatusBar->Text = "Success";
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```

2.3.1.3 ConfigureIODefaultOutput

Function:
bool SimpleIOClass::ConfigureIoDefaultOutput (unsigned char ucIoMap, unsigned char ucDefValue)

Summary: Configures the IO pins for Digital Input, Digital Output and also the default output latch value.
Description: IO Pins can be configured as Digital Input or Digital Output. The default output latch value is received as a parameter.
Precondition: VID and PID must be previously set via a call to InitMCP2200 (VID, PID).
Parameters:
1. ucIoMap - a byte that represents a bitmap used to set the GPIOs as either input or output.
   • '1' configures GPIO as input
   • '0' configures GPIO as output
   • MSB    –        –       –       –       –       –      LSB
     GP7  GP6  GP5  GP4  GP3  GP2  GP1  GP0
2. ucDefValue - the default value that will be loaded to the output latch (affects only the pins configured as outputs).
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: Error code is returned in LastError.

EXAMPLE 2-3:

```c
if (SimpleIOClass::ConfigureIoDefaultOutput(IoMap, DefValue) == SUCCESS)
    lblStatusBar->Text = "Success";
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```
2.3.1.4 ConfigureMCP2200

Function:
bool SimpleIOClass::ConfigureIoDefaultOutput (unsigned long BaudRateParam, unsigned int RxLEDMode, unsigned int TxLEDMode, bool FLOW, bool ULOAD, bool SSPND)

Summary: Configures the device.
Description: Sets the default GPIO designation, baud rate, TX/RX LED modes, flow control.
Precondition: VID and PID must be previously set via a call to InitMCP2200(VID, PID).
Parameters:
1. IOMap - A byte which represents the input/output state of the pins (each bit may be either a ‘1’ for input or ‘0’ for output.
2. BaudRateParam - the default communication baud rate.
3. RxLEDMode - can take one of the constant values (OFF, ON, TOGGLE, BLINKSLOW, BLINKFAST) to define the behavior of the Rx LED.
   • OFF = 0
   • ON = 1
   • TOGGLE = 3
   • BLINKSLOW = 4
   • BLINKFAST = 5
4. TxLEDMode - can take one of the defined values (OFF, ON, TOGGLE, BLINKSLOW, BLINKFAST) in order to define the behavior of the Tx LED.
5. FLOW - this parameter establishes the default flow control method (False - no HW flow control, True - RTS/CTS flow control).
6. ULOAD - this parameter establishes when the USB has loaded the configuration.
7. SSPND - this parameter establishes when the USB sends the Suspend mode signal.
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: None.

EXAMPLE 2-4:
```cpp
if (SimpleIOClass::ConfigureMCP2200(0x43, 9600, BLINKSLOW, BLINKFAST, false, false, false) == SUCCESS)
    lblStatusBar->Text = "Success";
else
    lblStatusBar->Text = "Invalid command "
```

2.3.1.5 fnHardwareFlowControl

Function:
bool SimpleIOClass::fnHardwareFlowControl (unsigned int onOff)

Summary: Configures the flow control of the MCP2200. The flow control configuration will be stored in NV/RAM.
Description: Sets the flow control to HW flow control (RTS/CTS) or no flow control.
Precondition: VID and PID must be previously set via a call to InitMCP2200(VID, PID).
Parameters: onOff:
   • '1' if HW flow control is required
   • '0' if no flow control is required
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: Error code is returned in LastError.

EXAMPLE 2-5:
```cpp
if (SimpleIOClass::fnHardwareFlowControl(1) == SUCCESS)
    lblStatusBar->Text = "Success";
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```
2.3.1.6 fnRxLED

Function:
bool SimpleIOClass::fnRxLED (unsigned int mode)

Summary: Configures the Rx LED mode. Rx LED configuration will be stored in NVRAM.
Description: Sets the Rx LED mode to one of the possible values.
Precondition: VID and PID must be previously set via a call to InitMCP2200 (VID, PID).
Parameters: mode (constant): OFF, TOGGLE, BLINKSLOW, BLINKFAST
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: Error code is returned in LastError.

EXAMPLE 2-6:

```c
if (SimpleIOClass::fnRxLED (BLINKFAST) == SUCCESS)
    lblStatusBar->Text = "Success";
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```

2.3.1.7 fnSetBaudRate

Function:
bool SimpleIOClass::fnSetBaudRate (unsigned long BaudRateParam)

Summary: Configures the device’s default baud rate. The baud rate value will be stored in NVRAM
Description: Sets the desired baud rate and it stores it into the device’s NVRAM.
Precondition: VID and PID must be previously set via a call to InitMCP2200 (VID, PID).
Parameters: BaudRateParam - the desired baud rate value
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: Error code is returned in LastError. This function is used only to set the default power-up baud rate value. When used with a terminal program, there is no need to call this function to change the baud rate. Changing the baud rate from the terminal program will send the appropriate CDC packet that will change the communication’s baud rate without the need to call this function.

EXAMPLE 2-7:

```c
if (SimpleIOClass::fnSetBaudRate (9600) == SUCCESS)
    lblStatusBar->Text = "Success";
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```

2.3.1.8 fnSuspend

Function:
bool SimpleIOClass::fnSuspend (unsigned int onOff)

Summary: Configures the GP0 pin of the MCP2200 to show the status of the USB Suspend/Resume states.
Description: When the GP0 is designated to show the USB Suspend/Resume states, the pin will go ‘low’ when the Suspend state is issued, or will go ‘high’ when the Resume state is on.
Precondition: VID and PID must be previously set via a call to InitMCP2200 (VID, PID).
Parameters: onOff:
• ‘1’ GP0 will reflect the USB Suspend/Resume states
• ‘0’ GP0 will not reflect the USB Suspend/Resume states (can be used as GPIO)
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: Error code is returned in LastError.
EXAMPLE 2-8:

```cpp
if (SimpleIOClass::fnSuspend(1) == SUCCESS)
    lblStatusBar->Text = "Success";
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```

2.3.1.9 fnTxLED

Function:
```cpp
bool SimpleIOClass::fnTxLED (unsigned int mode)
```

Summary: Configures the Tx LED mode. Tx LED configuration will be stored in NVRAM.

Description: Sets the Tx LED mode to one of the possible values.

Precondition: VID and PID must be previously set via a call to InitMCP2200(VID, PID).

Parameters:
- mode (constant): OFF, TOGGLE, BLINKSLOW, BLINKFAST

Returns: This function returns True if the transmission is successful and returns False if the transmission fails.

Remarks: Error code is returned in LastError.

EXAMPLE 2-9:

```cpp
if (SimpleIOClass::fnTxLED (BLINKSLOW) == SUCCESS)
    lblStatusBar->Text = "Success";
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```

2.3.1.10 fnULoad

Function:
```cpp
bool SimpleIOClass::fnULoad (unsigned int onOff)
```

Summary: Configures the GP1 pin of the MCP2200 to show the configuration status of the USB.

Description: When the GP1 is designated to show the USB configuration status, the pin will start 'low' (during power-up or after Reset), and it will go 'high' after the MCP2200 is successfully configured by the host.

Precondition: VID and PID must be previously set via a call to InitMCP2200(VID, PID).

Parameters:
- onOff:
  - '1': GP1 will reflect the USB configuration status
  - '0': GP1 will not reflect the USB configuration status (can be used as GPIO)

Returns: This function returns True if the transmission is successful and returns False if the transmission fails.

Remarks: Error code is returned in LastError.

EXAMPLE 2-10:

```cpp
if (SimpleIOClass::fnULoad(1) == SUCCESS)
    lblStatusBar->Text = "Success";
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```
2.3.1.11 GetDeviceInfo

Function:
String^ SimpleIOClass::GetDeviceInfo (unsigned int uiDeviceNo)

Summary: Returns the path name for one of the connected devices.
Description: The function will return the path name for the given device ID.
Precondition: At least one call to the InitMCP2200() is required in order to initiate a DLL search for the compatible devices.
VID and PID must be previously set via a call to InitMCP2200(VID, PID).
Parameters: uiDeviceNo: The device ID for which the path information is needed. Can have a value between 0 and the number of devices minus 1.
Returns: This function returns a string containing the path name of the given device id.
  • In the case the given ID is out of range, the function will return the "Device Index Error" string.
  • In the case the device for which the path name is required is not connected anymore, the return string will be "Device Not Connected".
Remarks: None.

EXAMPLE 2-11:

 lblStatusBar->Text = SimpleIOClass::GetDeviceInfo(0);

2.3.1.12 GetNoOfDevices

Function:
unsigned int SimpleIOClass::GetNoOfDevices(void)

Summary: The function returns the number of available devices present in the system.
Description: The function returns the number of HID devices (with the given VID/PID) connected to the system.
Precondition: At least one call to the InitMCP2200() is required in order to initiate a DLL search for the compatible devices. Also, in order to know the actual number of devices connected to the system, call the SimpleIOClass::IsConnected() function. VID and PID must be previously set via a call to InitMCP2200(VID, PID).
Parameters: None.
Returns: This function returns the number of HID devices with the given VID/PID (as parameters of the SimpleIOClass::InitMCP2200() function).
Remarks: Call the SimpleIOClass::IsConnected() function prior to the call of this function in order to have the most recent number of devices that are present in the system.

EXAMPLE 2-12:

 SimpleIOClass::IsConnected(); //call this function to refresh the number of //the devices present in the system
 lblStatusBar->Text = SimpleIOClass::GetNoOfDevices();

2.3.1.13 GetSelectedDevice

Function:
int SimpleIOClass::GetSelectedDevice(void)

Summary: Returns the ID of the selected device
Description: The function returns the ID of the current selected device.
Precondition: At least one call to the InitMCP2200() is required in order to initiate a DLL search for the compatible devices. VID and PID must be previously set via a call to InitMCP2200(VID, PID).
Parameters: None.
Returns: This function returns the ID of the current selected device. Its value can range from 0 to the number of devices minus 1.
Remarks: None.
EXAMPLE 2-13:

```cpp
lblStatusBar->Text = SimpleIOClass::GetSelectedDevice();
```

2.3.1.14 GetSelectedDeviceInfo

Function:
```cpp
String^ SimpleIOClass::GetSelectedDeviceInfo(void)
```

Summary: Returns the selected device path name.
Description: The function returns a string containing the unique path name of the selected device.
Precondition: At least one call to the `InitMCP2200()` is required in order to initiate a DLL search for the compatible devices. VID and PID must be previously set via a call to `InitMCP2200(VID, PID)`.
Parameters: None.
Returns: This function returns a string containing the unique path name of the selected device.
Remarks: The default selected device is the first one that the DLL finds. If the user wants to retrieve other devices path names (assuming more than one device is present in the system), a call to `SimpleIOClass::SelectDevice(deviceNo)` is required.

EXAMPLE 2-14:

```cpp
lblStatusBar->Text = SimpleIOClass::GetSelectedDeviceInfo(void)
```

2.3.1.15 InitMCP2200

Function:
```cpp
void SimpleIOClass::InitMCP2200 (unsigned int VendorID, unsigned int ProductID)
```

Summary: Configures the Simple IO class for a specific Vendor and product ID.
Description: Sets the Vendor and Product ID used for the project.
Precondition: None.
Parameters: 1. Vendor ID - assigned by USB IF (www.usb.org)
  2. Product ID - assigned by the Vendor ID Holder
Returns: None.
Remarks: Call this function before any other calls, to set the Vendor and Product IDs.

EXAMPLE 2-15:

```cpp
InitMCP2200 (0x4D8, 0x00DF);
```

2.3.1.16 isConnected

Function:
```cpp
bool SimpleIOClass::IsConnected()
```

Summary: Checks with the OS if the current VID/PID device is connected.
Description: Checks if a MCP2200 device is connected to the computer. If so, it returns True, otherwise the result will be False.
Precondition: VID and PID must be previously set via a call to `InitMCP2200(VID, PID)`.
Parameters: None.
Returns: True - if at least one device is connected to the host.
False - if there are no devices connected to the host.
Remarks: No actual communication with the end device is occurring. The function inquires the OS if the specified VID/PID was enumerated.
EXAMPLE 2-16:

```c
unsigned int rv;
if (SimpleIOC::IsConnected ())
{
    lblStatusBar->Text = "Device connected";
}
else
    lblStatusBar->Text = "Device Disconnected";
```

2.3.1.17  ReadEEPROM

Function:
```c
int SimpleIOC::ReadEEPROM (unsigned int uiEEPAddress)
```

Summary: Reads a byte from the EEPROM.
Description: Reads a byte from the EEPROM at the given address.
Precondition: At least one call to the `InitMCP2200()` is required in order to initiate a DLL search for the compatible devices. VID and PID must be previously set via a call to `InitMCP2200(VID, PID)`.
Parameters: `uiEEPAddress` - the EEPROM address location we need to write to (must be from 0 to 255, inclusively).
Returns: This function returns any positive value as being the EEPROM's location value:
- E_WRONG_ADDRESS (-3) - in case the given EEPROM address is out of range
- E_CANNOT_SEND_DATA (-4) - in case the function cannot send the command to the device
Remarks: None.

EXAMPLE 2-17:

```c
int iRetValue = SimpleIOC::ReadEEPROM(0x01);
if (iRetValue >= 0)
{
    lblStatusBar->Text = "Success";
}
else
    lblStatusBar->Text = "Error reading to EEPROM" +  SimpleIOC::LastError;
```

2.3.1.18  ReadPin

Function:
```c
bool SimpleIOC::ReadPin (unsigned int pin, unsigned int *returnvalue)
```

Summary: Reads the specified pin.
Description: Reads the specified pin and returns the value in `returnvalue`. If the pin has been configured as a digital input, the return value will be either '0' or '1'.
Precondition: Must be previously configured as an input via a `ConfigureIO` call. VID and PID must be previously set via a call to `InitMCP2200(VID, PID)`.
Parameters: • `pin` - the pin number to set (0-7)
- `returnvalue` - the value read on the pin ("0" or "1")
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: None.

EXAMPLE 2-18:

```c
unsigned int rv;
if (SimpleIOC::ReadGPIO (0, &rv))
{
    lblStatusBar->Text = "Success";
}
else
    lblStatusBar->Text = "Invalid command “ + SimpleIOC::LastError;
```
2.3.1.19 ReadPinValue

Function:
int SimpleIOClass::ReadPinValue(unsigned int pin)

Summary: Reads the specified pin.
Description: Reads the specified pin and returns the value as the return value. If the pin has been configured as a digital input, the return value will be either ‘0’ or ‘1’. If an error occurs, the function will return a value of 0x8000.
Precondition: Must be previously configured as an input via a ConfigureIO call. VID and PID must be previously set via a call to InitMCP2200(VID, PID).
Parameters: pin - the pin number to set (0-7)
Returns: This function returns the read value of the pin, or returns a value of 0x8000, if an error occurs.
Remarks: None.

EXAMPLE 2-19:

```c
unsigned int rv;
if (SimpleIOClass::ReadPinValue(0) != 0x8000)
{
    lblStatusBar->Text = "Success";
}
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```

2.3.1.20 ReadPort

Function:
bool SimpleIOClass::ReadPort(unsigned int *returnvalue)

Summary: Reads the GPIO port as digital input.
Description: Reads the GPIO port and returns the value in returnvalue. This provides a means to read all pins simultaneously, instead of one-by-one.
Precondition: Must be previously configured as an input via a ConfigureIO call. VID and PID must be previously set via a call to InitMCP2200(VID, PID).
Parameters: • pin - the pin number to set (0-7)
• returnvalue - the value read on the pin (‘0’ or ‘1’)
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: Pins configured for output return the current state of the port. Pins configured as input read as zero.

EXAMPLE 2-20:

```c
unsigned int rv;
if (SimpleIOClass::ReadGPIOPort (0, &rv))
{
    lblStatusBar->Text = "Success";
}
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```
2.3.1.21 ReadPortValue

Function:

```
int SimpleIOClass::ReadPortValue()
```

Summary: Reads the GPIO port as digital input.

Description: Reads the GPIO port and returns the value of the port. This provides a method to read all pins simultaneously, instead of one-by-one. In case of an error, the returned value will be 0x8000.

Precondition: Must be previously configured as an input via a ConfigureIO call. VID and PID must be previously set via a call to InitMCP2200 (VID, PID).

Parameters: None.

Returns: This function returns True if the transmission is successful and returns False if the transmission fails.

Remarks: Pins configured for output return the current state of the port. Pins configured as input read as zero.

EXAMPLE 2-21:

```
int rv;
r => SimpleIOClass::ReadPortValue();
if (rv != 0x8000)
{
    lblStatusBar->Text = "Success";
}
else
    lblStatusBar->Text => "Invalid command " + SimpleIOClass::LastError;
```

2.3.1.22 SelectDevice

Function:

```
int SimpleIOClass::SelectDevice(unsigned int uiDeviceNo)
```

Summary: Selects one of the active devices in the system.

Description: The function is used to select one of the detected devices in the system as the “active device”.

Precondition: At least one call to the InitMCP2200() is required in order to initiate a DLL search for the compatible devices. Also, in order to know the actual number of devices in the system, call the SimpleIOClass::IsConnected() function. VID and PID must be previously set via a call to InitMCP2200 (VID, PID).

Parameters: uiDeviceNo - the ID of the device to be selected (can have a value between 0 and the number of devices minus 1).

Returns: This function returns ‘0’ in case of selection success, otherwise it will return:

- E_WRONG_DEVICE_ID (-1) for a device ID that is out of range
- E_INACTIVE_DEVICE (-2) for an inactive device.

Remarks: Call the SimpleIOClass::IsConnected() prior to the call of this function in order to have the most recent number of devices that are present in the system.

EXAMPLE 2-22:

```
int iResult;
iResult = SimpleIOClass::SelectDevice(1);
if (iResult == 0)
{
    lblStatusBar->Text = "Success";
}
else
    lblStatusBar->Text = "Error selecting device";
```
2.3.1.23 SetPin

Function:
bool SimpleIOClass::SetPin(unsigned int pin)

Summary: Sets the specified pin.
Description: Sets the specified pin to logic ‘1’.
Precondition: Must be previously configured as an output via a ConfigureIO or ConfigureIoDefaultOutput call.
VID and PID must be previously set via a call to InitMCP2200(VID, PID).
Parameters: pin - the pin number to set (0-7)
Returns: This function returns True if the transmission is successful and returns False if the transmission fails.
Remarks: None.

EXAMPLE 2-23:

```cpp
if (SimpleIOClass::SetPin (2))
{
    lblStatusBar->Text = “Success”;
}
else
    lblStatusBar->Text = “Invalid command ” + SimpleIOClass::LastError;
```

2.3.1.24 WriteEEPROM

Function:
int SimpleIOClass::WriteEEPROM(unsigned int uiEEPAddress, unsigned char ucValue)

Summary: Writes a byte into the MCP2200 device’s EEPROM.
Description: Writes a byte at the given address into the internal 256 bytes EEPROM.
Precondition: At least one call to the InitMCP2200() is required in order to initiate a DLL search for the compatible devices. VID and PID must be previously set via a call to InitMCP2200(VID, PID).
Parameters:
• uiEEPAddress - the EEPROM address location to write to (must be from 0 to 255 inclusively).
• ucValue - the byte value required for writing to the given location.
Returns: This function returns ‘0’ if the write command was successfully sent to the device, otherwise it returns:
• E_WRONG_ADDRESS (-3) in case the given EEPROM address is out of range
• E_CANNOT_SEND_DATA (-4) in case the function cannot send the command to the device.
Remarks: The function will send the write EEPROM command, but has no confirmation whether the EEPROM location was actually written. In order to verify the correctness of the EEPROM write, the user can issue a SimpleIOClass::ReadEEPROM() and check if the returned value matches the written one.

EXAMPLE 2-24:

```cpp
int iRetValue = SimpleIOClass::WriteEEPROM(0x01, 0xAB);
if (iRetValue == 0)
{
    lblStatusBar->Text = “Success”;
}
else
    lblStatusBar->Text = “Error writting to EEPROM” + SimpleIOClass::LastError;
```
2.3.1.25 WritePort

Function:

```cpp
bool SimpleIOClass::WritePort(unsigned int portValue)
```

Summary: Writes a value to the GPIO port.

Description: Writes the GPIO port. This provides a means to write all pins simultaneously, instead of one-by-one.

Precondition: Must be previously configured as an output via a ConfigureIO call. VID and PID must be previously set via a call to InitMCP2200(VID, PID).

Parameters: portValue - byte value to set on the port.

Returns: This function returns True if the transmission is successful and returns False if the transmission fails.

Remarks: None.

EXAMPLE 2-25:

```cpp
if (SimpleIOClass::WritePort (0x5A))
{
    lblStatusBar->Text = "Success";
}
else
    lblStatusBar->Text = "Invalid command " + SimpleIOClass::LastError;
```
3.0  Electrical Characteristics

Absolute Maximum Ratings (†)

Ambient temperature under bias ......................................................................................................... -40°C to +85°C
Storage temperature ........................................................................................................................ -65°C to +150°C
Voltage on VDD with respect to VSS ................................................................................................... -0.3V to +6.0V
Voltage on MCLR with respect to Vss ................................................................................................... -0.3V to +9.0V
Voltage on VUSB(1) pin with respect to VSS ........................................................................................ -0.3V to +4.0V
Voltage on D+ and D- pins with respect to Vss ................................................................................... -0.3V to (VUSB + 0.3V)
Total power dissipation (2) ...................................................................................................................... 800 mW
Maximum current out of VSS pin ............................................................................................................ 95 mA
Maximum current into VDD pin ................................................................................................................ 95 mA
Clamp current, IK (VPIN < 0 or VPIN > VDD) .......................................................................................... ± 20 mA
Maximum output current sunk by any I/O pin ....................................................................................... 25 mA
Maximum output current sourced by any I/O pin .................................................................................. 25 mA
Maximum current sunk by all ports ....................................................................................................... 90 mA
Maximum current sourced by all ports .................................................................................................. 90 mA

Note 1:  VUSB must always be ≤ VDD + 0.3V.
2:  Power dissipation is calculated as follows: PDIS = VDD x (IDD – ∑ IOH) + ∑ ((VDD – VOH) x IOH) + ∑ (VOL x IOL).

† NOTICE: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure above maximum rating conditions for extended periods may affect device reliability.
### 3.1 DC Characteristics

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<tr>
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<td>VDD</td>
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<td>—</td>
<td>5.5</td>
<td>V</td>
<td></td>
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<td>1.6</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power-on Reset Rearm Voltage</td>
<td>VDD</td>
<td>0.8</td>
<td>—</td>
<td>—</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>D002</td>
<td>VDD Rise Rate to Ensure Power-on Reset</td>
<td>SVDD</td>
<td>0.05</td>
<td>—</td>
<td>—</td>
<td>V/mS</td>
<td>Design guidance only, Not tested</td>
</tr>
<tr>
<td>D003</td>
<td>Supply Current</td>
<td>I DD</td>
<td>—</td>
<td>—</td>
<td>10</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VDD = 3.0V</td>
<td></td>
<td>—</td>
<td>—</td>
<td>10</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VDD = 5.0V</td>
<td></td>
<td>—</td>
<td>—</td>
<td>10</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>D004</td>
<td>Standby Current</td>
<td>IDSS</td>
<td>—</td>
<td>—</td>
<td>9</td>
<td>µA</td>
<td></td>
</tr>
</tbody>
</table>

### Input Low-Voltage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D031</td>
<td>Schmitt Trigger (GPIO)</td>
<td>VIL</td>
<td>—</td>
<td>—</td>
<td>0.2</td>
<td>V/VDD</td>
<td>3.0V ≤ VDD ≤ 5.5V</td>
</tr>
<tr>
<td></td>
<td>TTL (CTS pin)</td>
<td></td>
<td>—</td>
<td>—</td>
<td>0.2</td>
<td>V/VDD</td>
<td></td>
</tr>
</tbody>
</table>

### Input High-Voltage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D041</td>
<td>Schmitt Trigger (GPIO)</td>
<td>VIH</td>
<td>0.8</td>
<td>—</td>
<td>VDD</td>
<td>V/VDD</td>
<td>3.0V ≤ VDD ≤ 5.5V</td>
</tr>
<tr>
<td></td>
<td>TTL (RTS pin)</td>
<td></td>
<td>—</td>
<td>—</td>
<td>VDD</td>
<td>V/VDD</td>
<td></td>
</tr>
</tbody>
</table>

### Input Leakage Current

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D060</td>
<td>GPIO, CTS</td>
<td>IIL</td>
<td>—</td>
<td>±50</td>
<td>±100</td>
<td>nA/VSS</td>
<td>VSS ≤ VPIN ≤ VDD, pin at High Z</td>
</tr>
<tr>
<td></td>
<td>RST</td>
<td></td>
<td>—</td>
<td>±50</td>
<td>±200</td>
<td>nA/VDD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OSC1</td>
<td></td>
<td>—</td>
<td>±50</td>
<td>±100</td>
<td>nA/VDD</td>
<td></td>
</tr>
</tbody>
</table>

### Output Low-Voltage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D080</td>
<td>GPIO, UART Tx/Rx</td>
<td>VOL</td>
<td>—</td>
<td>—</td>
<td>0.6</td>
<td>V/IOL</td>
<td>IOL = 8.0 mA, VDD = 5.0V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
<td>0.6</td>
<td>V/IOL</td>
<td>IOL = 6.0 mA, VDD = 3.3V</td>
</tr>
</tbody>
</table>

### Output High-Voltage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D090</td>
<td>GPIO, UART Tx/Rx</td>
<td>VOH</td>
<td>VDD</td>
<td>0.7</td>
<td>—</td>
<td>V/IOH</td>
<td>IOH = -3.5 mA, VDD = 5.0V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>VDD</td>
<td>0.7</td>
<td>—</td>
<td>V/IOH</td>
<td>IOH = -3.0 mA, VDD = 3.3V</td>
</tr>
</tbody>
</table>

### Capacitive Loading Specifications on Output Pins

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D101</td>
<td>OSC2</td>
<td>COSC2</td>
<td>—</td>
<td>—</td>
<td>15</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>D102</td>
<td>GPIO</td>
<td>CIO</td>
<td>—</td>
<td>—</td>
<td>50</td>
<td>pF</td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** This parameter is characterized, but not tested.
FIGURE 3-1: POR AND POR REARM WITH SLOW RISING VDD

Note 1: When NPOR is low, the device is held in Reset.
2: TPOR 1 µs typical.
3: TVLOW 2.7 µs typical.

TABLE 3-1: USB MODULE SPECIFICATIONS

<table>
<thead>
<tr>
<th>DC Characteristics</th>
<th>Operating Conditions (unless otherwise indicated): 3.0V ≤ VDD ≤ 5.5V at -40°C ≤ TA ≤ +85°C (I-Temp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-----------</td>
<td>----------------</td>
</tr>
<tr>
<td>D313</td>
<td>USB Voltage</td>
</tr>
<tr>
<td>D314</td>
<td>Input Leakage on Pin</td>
</tr>
<tr>
<td>D315</td>
<td>Input Low Voltage for USB Buffer</td>
</tr>
<tr>
<td>D316</td>
<td>Input High Voltage for USB Buffer</td>
</tr>
<tr>
<td>D318</td>
<td>Differential Input Sensitivity</td>
</tr>
<tr>
<td>D319</td>
<td>Differential Common Mode Range</td>
</tr>
<tr>
<td>D320</td>
<td>Driver Output Impedance(1)</td>
</tr>
<tr>
<td>D321</td>
<td>Voltage Output Low</td>
</tr>
<tr>
<td>D322</td>
<td>Voltage Output High</td>
</tr>
</tbody>
</table>

Note 1: The D+ and D- signal lines have been built-in impedance matching resistors. No external resistors, capacitors or magnetic components are necessary on the D+/D- signal paths between the MCP2200 family device and the USB cable.
**TABLE 3-2: THERMAL CONSIDERATIONS**

Standard Operating Conditions (unless otherwise stated)
Operating temperature: -40°C ≤ TA ≤ +85°C (I-Temp)

<table>
<thead>
<tr>
<th>Param. No.</th>
<th>Sym.</th>
<th>Characteristic</th>
<th>Typ.</th>
<th>Units</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH01</td>
<td>θJA</td>
<td>Thermal Resistance Junction to Ambient</td>
<td>36.1</td>
<td>°C/W</td>
<td>20-pin VQFN 5x5 mm package</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>85.2</td>
<td>°C/W</td>
<td>20-pin SOIC package</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>108.1</td>
<td>°C/W</td>
<td>20-pin SSOP package</td>
</tr>
<tr>
<td>TH02</td>
<td>θJC</td>
<td>Thermal Resistance Junction to Case</td>
<td>1.7</td>
<td>°C/W</td>
<td>20-pin VQFN 5x5 mm package</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24</td>
<td>°C/W</td>
<td>20-pin SOIC package</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24</td>
<td>°C/W</td>
<td>20-pin SSOP package</td>
</tr>
<tr>
<td>TH03</td>
<td>TJMAX</td>
<td>Maximum Junction Temperature</td>
<td>150</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>TH04</td>
<td>PD</td>
<td>Power Dissipation</td>
<td>—</td>
<td>W</td>
<td>PD = PINTERNAL + PI/O</td>
</tr>
<tr>
<td>TH05</td>
<td>PINTERNAL</td>
<td>Internal Power Dissipation</td>
<td>—</td>
<td>W</td>
<td>PINTERNAL = IDD x VDD(1)</td>
</tr>
<tr>
<td>TH06</td>
<td>PI/O</td>
<td>I/O Power Dissipation</td>
<td>—</td>
<td>W</td>
<td>PI/O = Σ (IOL * VOL) + Σ (IOH * (VDD – VOH))</td>
</tr>
<tr>
<td>TH07</td>
<td>PDER</td>
<td>Derated Power</td>
<td>—</td>
<td>W</td>
<td>PDER = PDMAX (TJ - TA)/θJA(2,3)</td>
</tr>
</tbody>
</table>

**Note**

1: IDD is the current to run the chip alone without driving any load on the output pins.
2: TA = Ambient Temperature.
3: TJ = Junction Temperature.
3.2 AC Characteristics

3.2.1 TIMING PARAMETER SYMBOLOGY

The timing parameter symbols have been created in one of the following formats:

1. TppS2ppS
2. TppS

<table>
<thead>
<tr>
<th>T</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Frequency</td>
</tr>
<tr>
<td>E</td>
<td>Error</td>
</tr>
<tr>
<td>T</td>
<td>Time</td>
</tr>
</tbody>
</table>

Lowercase letters (pp) and their meanings:

<table>
<thead>
<tr>
<th>pp</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>io</td>
<td>Input or Output pin</td>
</tr>
<tr>
<td>rx</td>
<td>Receive</td>
</tr>
<tr>
<td>bitclk</td>
<td>RX/TX BITCLK</td>
</tr>
<tr>
<td>drt</td>
<td>Device Reset Timer</td>
</tr>
</tbody>
</table>

Uppercase letters and their meanings:

<table>
<thead>
<tr>
<th>S</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Fall</td>
</tr>
<tr>
<td>H</td>
<td>High</td>
</tr>
<tr>
<td>I</td>
<td>Invalid (high-impedance)</td>
</tr>
<tr>
<td>L</td>
<td>Low</td>
</tr>
<tr>
<td>P</td>
<td>Period</td>
</tr>
<tr>
<td>R</td>
<td>Rise</td>
</tr>
<tr>
<td>V</td>
<td>Valid</td>
</tr>
<tr>
<td>Z</td>
<td>High-impedance</td>
</tr>
</tbody>
</table>

3.2.2 TIMING CONDITIONS

The operating temperature and voltage specified in Table 3-3 apply to all timing specifications unless otherwise noted. Figure 3-2 specifies the load conditions for the timing specifications.

TABLE 3-3: TEMPERATURE AND VOLTAGE SPECIFICATIONS - AC

<table>
<thead>
<tr>
<th>AC CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Operating Conditions (unless otherwise stated)</td>
</tr>
<tr>
<td>Operating temperature: (-40°C \leq TA \leq +85°C)</td>
</tr>
<tr>
<td>Operating voltage (V_{DD}) range as described in DC spec, Section 3.1 &quot;DC Characteristics&quot;.</td>
</tr>
</tbody>
</table>

FIGURE 3-2: LOAD CONDITIONS FOR DEVICE TIMING SPECIFICATIONS

- Pin
- 50 pF (15 pF for OSC2)
### 3.2.3 TIMING SPECIFICATIONS

**TABLE 3-4: RESET, OSCILLATOR START-UP TIMER AND POWER-UP TIMER PARAMETERS**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>TRST</td>
<td>MCLR Pulse Width (low)</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>μs</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>TPWRT</td>
<td>Power-Up Timer</td>
<td>40</td>
<td>65</td>
<td>140</td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>TOST</td>
<td>Oscillator Startup Time</td>
<td>—</td>
<td>1024</td>
<td>—</td>
<td>TOST</td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** These parameters are characterized but not tested.

**Note 2:** Data in “Typ.” column is at 5V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

Legend:

XX...X  Customer-specific information
Y       Year code (last digit of calendar year)
YY      Year code (last 2 digits of calendar year)
WW      Week code (week of January 1 is week ‘01’)
NNN     Alphanumeric traceability code
Pb-free JEDEC® designator for Matte Tin (Sn)
*       This package is Pb-free. The Pb-free JEDEC® designator (e3) can be found on the outer packaging for this package.

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.
20-Lead Plastic Quad Flat, No Lead Package (MQ) – 5x5x1.0 mm Body [VQFN] With 0.40 mm Contact Length

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging
20-Lead Plastic Quad Flat, No Lead Package (MQ) – 5x5x1.0 mm Body [VQFN]  
With 0.40 mm Contact Length

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

<table>
<thead>
<tr>
<th>Units</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension Limits</td>
<td>MIN</td>
</tr>
<tr>
<td>Number of Terminals</td>
<td>N e</td>
</tr>
<tr>
<td>Pitch</td>
<td>e</td>
</tr>
<tr>
<td>Overall Height</td>
<td>A</td>
</tr>
<tr>
<td>Standoff</td>
<td>A1</td>
</tr>
<tr>
<td>Contact Thickness</td>
<td>(A3)</td>
</tr>
<tr>
<td>Overall Length</td>
<td>D</td>
</tr>
<tr>
<td>Exposed Pad Length</td>
<td>D2</td>
</tr>
<tr>
<td>Overall Width</td>
<td>E</td>
</tr>
<tr>
<td>Exposed Pad Width</td>
<td>E2</td>
</tr>
<tr>
<td>Contact Width</td>
<td>b</td>
</tr>
<tr>
<td>Contact Length</td>
<td>L</td>
</tr>
<tr>
<td>Contact-to-Exposed Pad</td>
<td>K</td>
</tr>
</tbody>
</table>

Notes:
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.
MCP2200

20-Lead Plastic Quad Flat, No Lead Package (MQ) – 5x5x1.0 mm Body [VQFN]
With 0.40 mm Contact Length

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

RECOMMENDED LAND PATTERN

<table>
<thead>
<tr>
<th>Units</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension Limits</td>
<td>MIN</td>
</tr>
<tr>
<td>Contact Pitch</td>
<td>E</td>
</tr>
<tr>
<td>Optional Center Pad Width</td>
<td>W2</td>
</tr>
<tr>
<td>Optional Center Pad Length</td>
<td>T2</td>
</tr>
<tr>
<td>Contact Pad Spacing</td>
<td>C1</td>
</tr>
<tr>
<td>Contact Pad Spacing</td>
<td>C2</td>
</tr>
<tr>
<td>Contact Pad Width (X20)</td>
<td>X1</td>
</tr>
<tr>
<td>Contact Pad Length (X20)</td>
<td>Y1</td>
</tr>
<tr>
<td>Distance Between Pads</td>
<td>G</td>
</tr>
<tr>
<td>Thermal Via Diameter</td>
<td>V</td>
</tr>
<tr>
<td>Thermal Via Pitch</td>
<td>EV</td>
</tr>
</tbody>
</table>

Notes:
1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-2139B (MQ)
20-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

Microchip Technology Drawing C04-094C Sheet 1 of 2
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

<table>
<thead>
<tr>
<th>Units</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension</td>
<td>MIN</td>
</tr>
<tr>
<td>Number of Pins</td>
<td>N</td>
</tr>
<tr>
<td>Pitch</td>
<td>e</td>
</tr>
<tr>
<td>Overall Height</td>
<td>A</td>
</tr>
<tr>
<td>Molded Package Thickness</td>
<td>A2</td>
</tr>
<tr>
<td>Standoff</td>
<td>§</td>
</tr>
<tr>
<td>Overall Width</td>
<td>E</td>
</tr>
<tr>
<td>Molded Package Width</td>
<td>E1</td>
</tr>
<tr>
<td>Overall Length</td>
<td>D</td>
</tr>
<tr>
<td>Chamfer (Optional)</td>
<td>h</td>
</tr>
<tr>
<td>Foot Length</td>
<td>L</td>
</tr>
<tr>
<td>Footprint</td>
<td>L1</td>
</tr>
<tr>
<td>Lead Angle</td>
<td>Θ</td>
</tr>
<tr>
<td>Foot Angle</td>
<td>Ψ</td>
</tr>
<tr>
<td>Lead Thickness</td>
<td>c</td>
</tr>
<tr>
<td>Lead Width</td>
<td>b</td>
</tr>
<tr>
<td>Mold Draft Angle Top</td>
<td>α</td>
</tr>
<tr>
<td>Mold Draft Angle Bottom</td>
<td>β</td>
</tr>
</tbody>
</table>

Notes:
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A & B to be determined at Datum H.
20-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

![Recommended Land Pattern Diagram]

<table>
<thead>
<tr>
<th>Units</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension Limits</td>
<td>MIN</td>
</tr>
<tr>
<td>Contact Pitch</td>
<td>E</td>
</tr>
<tr>
<td>Contact Pad Spacing</td>
<td>C</td>
</tr>
<tr>
<td>Contact Pad Width (X20)</td>
<td>X</td>
</tr>
<tr>
<td>Contact Pad Length (X20)</td>
<td>Y</td>
</tr>
<tr>
<td>Distance Between Pads</td>
<td>Gx</td>
</tr>
<tr>
<td>Distance Between Pads</td>
<td>G</td>
</tr>
</tbody>
</table>

Notes:
1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2094A
20-Lead Plastic Shrink Small Outline (SS) – 5.30 mm Body [SSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

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<td>Number of Pins</td>
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<td>Molded Package Thickness</td>
<td>A2</td>
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<tr>
<td>Standoff</td>
<td>A1</td>
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<td>Overall Width</td>
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<tr>
<td>Molded Package Width</td>
<td>E1</td>
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<tr>
<td>Overall Length</td>
<td>D</td>
</tr>
<tr>
<td>Foot Length</td>
<td>L</td>
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<tr>
<td>Footprint</td>
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<tr>
<td>Lead Thickness</td>
<td>c</td>
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<tr>
<td>Foot Angle</td>
<td>φ</td>
</tr>
<tr>
<td>Lead Width</td>
<td>b</td>
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Notes:
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.20 mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M.
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-072B
20-Lead Plastic Shrink Small Outline (SS) - 5.30 mm Body [SSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

RECOMMENDED LAND PATTERN

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<td>Contact Pad Spacing</td>
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<tr>
<td>Contact Pad Length (X20)</td>
<td>Y1</td>
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<tr>
<td>Distance Between Pads</td>
<td>G</td>
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Notes:
1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2072A
APPENDIX A:  REVISION HISTORY

Revision C (December 2015)
1. Added Windows® 8, Windows 8.1 and Windows 10 to Features and Section 1.1 “Supported Operating Systems”.

Revision B (March 2011)
The following is the list of modifications:
1. Added new section Section 1.5.2.
2. Updated entire Section 2.3 “Simple Configuration and I/O DLL”.
3. Added values to parameters TH01 and TH02 for the 20-Lead 5x5 VQFN package in Table 3-2.

Revision A (March 2010)
Original Release of this Document.
**PRODUCT IDENTIFICATION SYSTEM**

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip sales office.

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<th>PART NO.</th>
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<th>X</th>
<th>XX</th>
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<tr>
<td>Device</td>
<td>Tape and Reel</td>
<td>Temperature Range</td>
<td>Package</td>
</tr>
</tbody>
</table>

Device: MCP2200: USB-to-UART serial converter  
MCP2200T: USB-to-UART serial converter (Tape and Reel)

Tape and Reel Option:  
Blank = Standard packaging (tube or tray)  
T = Tape and Reel (1)  

Temperature Range:  
I = -40°C to +85°C (Industrial)

Package:  
MQ = Plastic Quad Flat, No Lead Package  
5x5x1 mm Body (VQFN), 20-Lead  
SO = Plastic Small Outline - Wide, 7.50 mm Body (SO), 20-Lead  
SS = Plastic Shrink Small Outline - 5.30 mm Body (SS), 20-Lead

**Examples:**

- a) MCP2200- I/MQ: Industrial temperature, 20LD VQFN Package.
- b) MCP2200T- I/MQ: Tape and Reel, Industrial temperature, 20LD VQFN Package.
- c) MCP2200- I/SO: Industrial temperature, 20LD SOIC Package.
- d) MCP2200T- I/SO: Tape and Reel, Industrial temperature, 20LD SOIC Package.
- e) MCP2200- I/SS: Industrial temperature, 20LD SSOP Package.
- f) MCP2200T- I/SS: Tape and Reel, Industrial temperature, 20LD SSOP Package.

**Note 1:** Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.
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