# MCP2200

## USB 2.0 to UART Protocol Converter with GPIO

## Features

### Universal Serial Bus (USB)

- Supports full-speed USB (12 Mb/s)
- Implements USB protocol composite device CDC device for communications, configuration and 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 (certification #: TBD)

### USB Driver and Software Support

- Uses standard Microsoft® Windows® drivers for Virtual Com Port (VCP):
  - Windows XP(SP2 and later)/Vista/7
- 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 (8) 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 if requested current is allowed)
- Operating voltage: 3.0-5.5V
- Oscillator input: 12 MHz
- ESD protection > 4 kV HBM
- Industrial (I) Operating Temperature: -40°C to +85°C
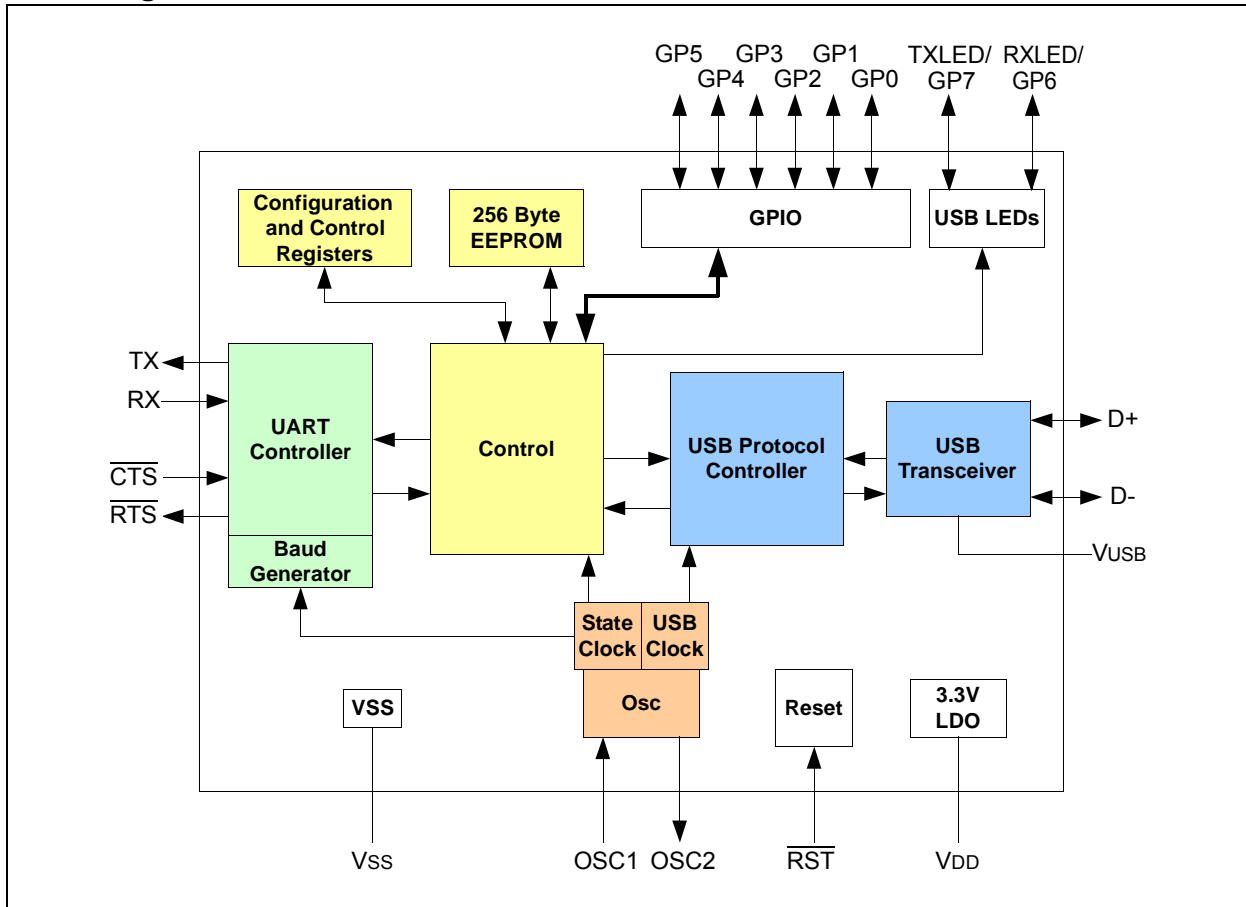
## Package Types

The device will be offered in the following packages:

- 20-lead QFN (5 x 5[mm])
- 20-lead SOIC
- 20-lead SSOP



* Includes Exposed Thermal Pad (EP); see Table 1-1.
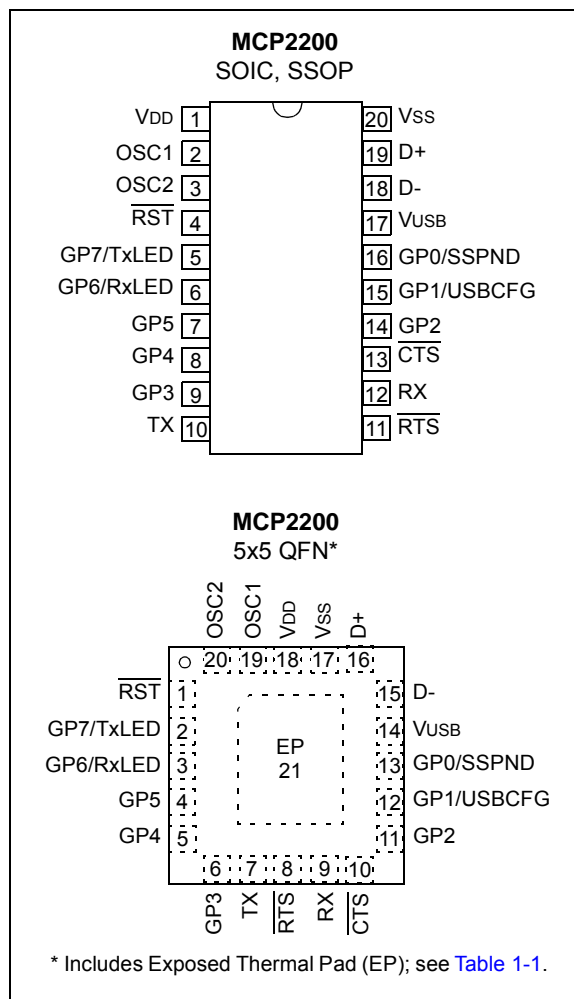
# MCP2200

**Block Diagram**

## 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**

| Pin Name | SSOP, SOIC | QFN | Pin Type | Standard Function | Alternate Function |
|---|---|---|---|---|---|
| GP0/SSPND | 16 | 13 | I/O | General purpose I/O | USB suspend status pin (refer to **Section 1.6.1.1 "SSPND Pin Function"**) |
| GP1/USBCFG | 15 | 12 | I/O | General purpose I/O | USB configuration status pin (refer to **Section 1.6.1.2 "USB-CFG Pin Function"**) |
| GP2 | 14 | 11 | I/O | General purpose I/O | |
| GP3 | 9 | 6 | I/O | General purpose I/O | |
| GP4 | 8 | 5 | I/O | General purpose I/O | |
| GP5 | 7 | 4 | I/O | General purpose I/O | |
| GP6/RxLED | 6 | 3 | I/O | General purpose I/O | USB receive activity LED output (refer to **Section 1.6.1.3 "RxLED Pin Function (IN Message)"**) |
| GP7/TxLED | 5 | 2 | I/O | General purpose I/O | USB transmit activity LED output (refer to **Section 1.6.1.4 "TxLED Pin Function (OUT Message)"**) |
| $\overline{RST}$ | 4 | 1 | I | Reset input must be externally biased | |
| $\overline{CTS}$ | 13 | 10 | I | Hardware flow control "Clear to Send" input signal | |
| RX | 12 | 9 | I | USART RX input | |
| $\overline{RTS}$ | 11 | 8 | O | Hardware flow control "Request to Send" output signal | |
| TX | 10 | 7 | O | USART TX output | |
| $V_{DD}$ | 1 | 18 | P | Power | |
| $V_{SS}$ | 20 | 17 | P | Ground | |
| OSC1 | 2 | 19 | I | Oscillator input | |
| OSC2 | 3 | 20 | O | Oscillator output | |
| D+ | 19 | 16 | I/O | USB D+ | |
| D- | 18 | 15 | I/O | USB D- | |
| $V_{USB}$ | 17 | 14 | P | USB power pin (internally connected to 3.3V). Should be locally bypassed with a high quality ceramic capacitor. | |
| EP | — | 21 | — | Exposed Thermal Pad (EP). Do not electrically connect, or connect to VSS. | |

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# MCP2200

## 1.1 Supported Operating Systems

Microsoft Windows XP(SP2 and later)/Vista/7 operating systems are supported.

### 1.1.1 ENUMERATION

The MCP2200 will enumerate as a USB device after POR. The device enumerates as both a Human Interface Device (HID) for I/O control, and a VCP.

#### 1.1.1.1 HID

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

#### 1.1.1.2 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 command requests generated by the USB host controller, and 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 $\overline{\text{RTS}}/\overline{\text{CTS}}$ flow control pins.

The UART is configurable for several baud rates. The available data formats and 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. The primary baud rates are shown in Table 1-3.

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.

### 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) are 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 1-2: UART CONFIGURATIONS**

| Parameter | Configuration |
|---|---|
| Primary Baud Rates | See Table 1-3 |
| Data Bits | 8 |
| Parity | N |
| Stop Bits | 1 |

### 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 $\overline{RTS}$ and $\overline{CTS}$ pins as a handshake between two devices. The $\overline{RTS}$ pin of one device is typically connected to the $\overline{CTS}$ of the other device.

$\overline{RTS}$ is an active low output which notifies the other device when it can receive data by driving the pin low. The MCP2200 trip point for de-asserting $\overline{RTS}$ (high) is 63 characters. This is one character short of "buffer full".

$\overline{CTS}$ is an active low input which is used to notify the MCP2200 when it can send data. The MCP2200 will check $\overline{CTS}$ 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.

**FIGURE 1-1:   RTS/CTS CONNECTIONS EXAMPLE**
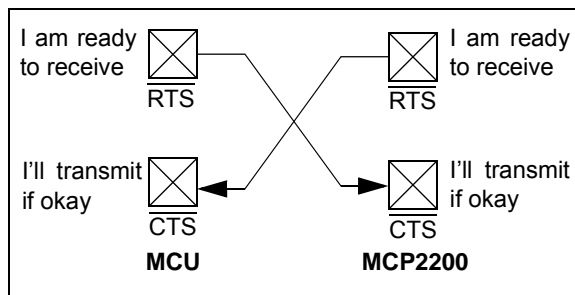


**EQUATION 1-1:   SOLVING FOR ACTUAL BAUD RATE**

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

Where:

$$x = \frac{12MHz}{DesiredBaud}$$

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

| Desired Rate | Actual rate | % Error |
|---|---|---|
| 300 | 300 | 0.00% |
| 1200 | 1200 | 0.00% |
| 2400 | 2400 | 0.00% |
| 4800 | 4800 | 0.00% |
| 9600 | 9600 | 0.00% |
| 19200 | 19200 | 0.00% |
| 38400 | 38339 | 0.16% |
| 57600 | 57692 | 0.16% |
| 115200 | 115385 | 0.16% |
| 230400 | 230769 | 0.16% |
| 460800 | 461538 | 0.16% |
| 921600 | 923077 | 0.16% |

## 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

The descriptors are stored in the MCP2200 during configuration using the supplied PC interface.

### 1.4.2   SUSPEND AND RESUME

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

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

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

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## 1.5 USB Transceiver

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

The USB transceiver obtains power from the V$_{USB}$ pin, which is internally connected to the 3.3V regulator. The best electrical signal quality is obtained when V$_{USB}$ 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.

#### 1.5.1.1 Bus Power Only

In Bus Power Only mode, all power for the application is drawn from the USB (Figure 1-2). This is effectively the simplest power method for the device.

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 not, some kind of inrush limiting is required. For more details, see Section 7.2.4 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 V$_{BUS}$ 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.

During USB Suspend mode, the D+ or D- pull-up resistor must remain active, which will consume some of the allowed suspend current budget (500 µA/ 2.5 mA).

**FIGURE 1-2: BUS POWER ONLY**
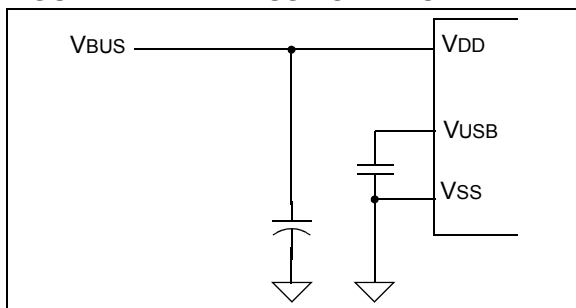


## 1.6 GPIO Module

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 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 $\overline{RST}$ 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 POR

A Power-on Reset 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 $\overline{RST}$ pin through a resistor (1 kOhm to 10 kOhm) to VDD. This will eliminate external RC components usually needed to create a Power-on Reset 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 nominally 12 Mb/s. The clock input accuracy is ±0.25% (2,500 ppm maximum).
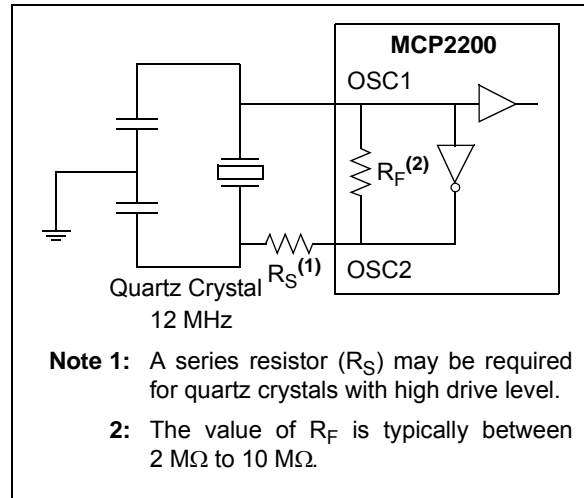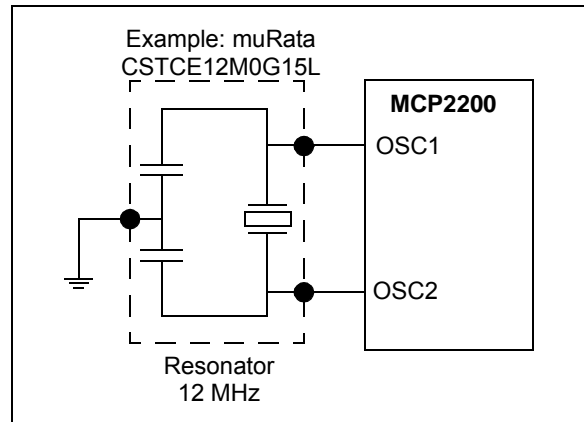
**FIGURE 1-3:** QUARTZ CRYSTAL OPERATION



**Note 1:** A series resistor ($R_S$) may be required for quartz crystals with high drive level.

**2:** The value of $R_F$ is typically between 2 MΩ to 10 MΩ.

**FIGURE 1-4:** CERAMIC RESONATOR OPERATION

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## 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

A configuration utility is provided by Microchip to allow the user to configure the MCP2200 to custom defaults. The Configuration Utility (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 2-1: CONFIGURATION DESCRIPTIONS

| Configuration Name | Description |
|---|---|
| Vendor ID (0x04D8) | The USB vendor identification assigned to Microchip by the USB consortium. |
| Product ID (0x00DF) | Device ID assigned by Microchip. The device can be used "as-is", or Microchip can assign a custom PID by request. |
| Baud Rate | Sets the UART baud rate using a list of primary baud rates. See the UART section for details on setting non-primary baud rates. |
| IO Config | Individually configures the I/O to inputs or outputs. |
| IO Default | Individually configures the output default state for pins configured as outputs. |
| Tx/Rx LEDs | Enables/disables the GP6 and GP7 pins to function as USB traffic indicators. Pins are active low when configured as traffic indicators. |
| Hardware Flow Control | Enables/disables $\overline{CTS}$ and $\overline{RTS}$ flow control. |
| USBCFG Pin | Enables/disables the GP1 pin as a USB configuration status indicator. |
| Suspend Pin | Enables/disables the GP0 pin as a USB suspend status pin. |
| Invert Sense | Enables/disables the UART lines states:<br>- Normal – Tx/Rx idle high; $\overline{CTS}/\overline{RTS}$ active low<br>- Inverted – Tx/Rx idle low; $\overline{CTS}/\overline{RTS}$ active high |
| Manufacturer String | USB manufacturer string. |
| Product String | USB product string. |

**FIGURE 2-1:** **CONFIGURATION UTILITY**
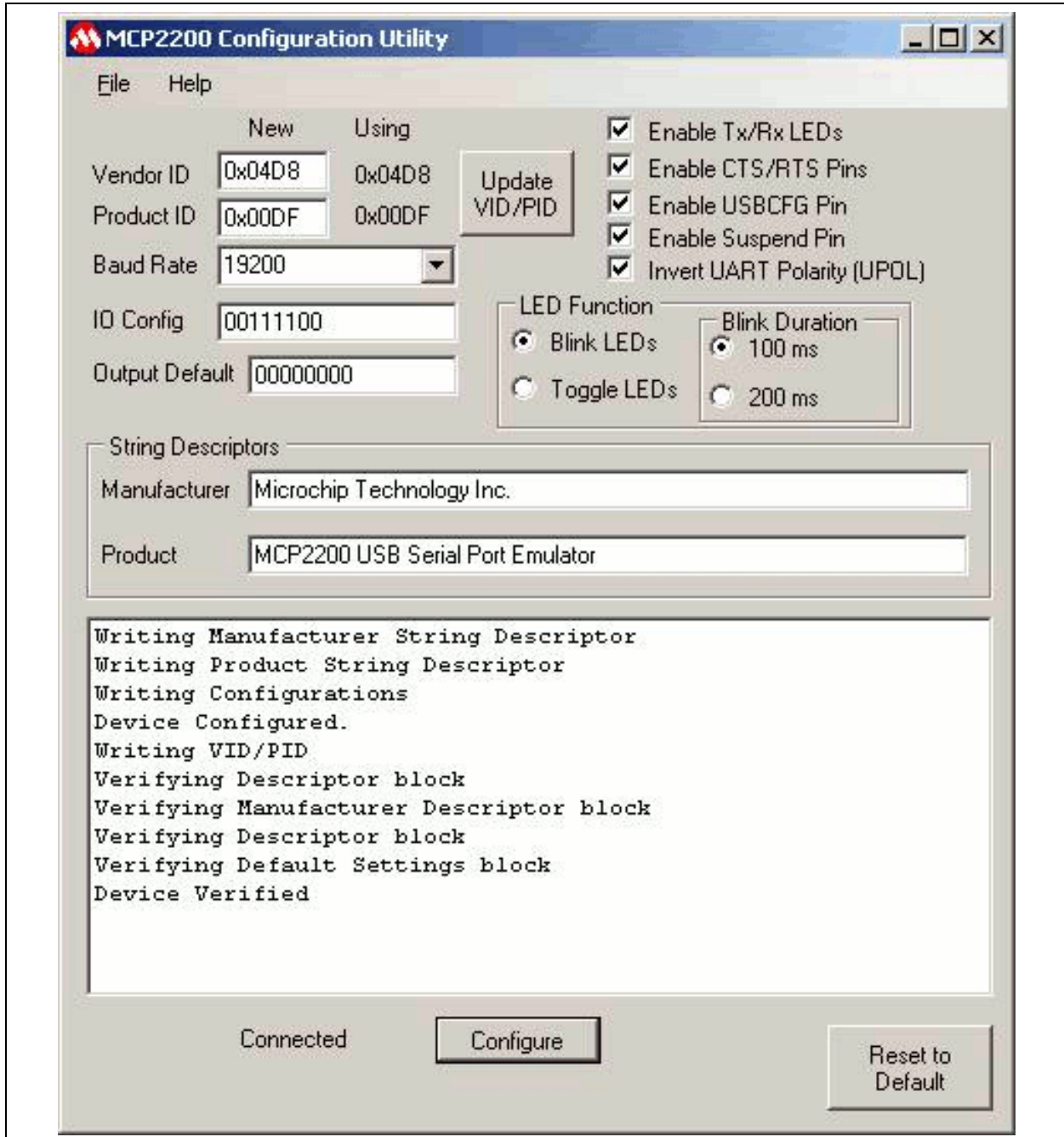
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## 2.3 Simple Configuration and I/O DLL

A DLL is provided by Microchip to help the user develop a custom configurator. See the documentation on the MCP2200 product page for details on associating the DLL with a Visual C++ project.

### 2.3.1 SIMPLE I/O DLL CALLS

The DLL provides the following functions to allow configuration of the device and control of the I/O.

#### 2.3.1.1 Initialization

```
void InitMCP2200(VID, PID)
bool IsConnected()
```

#### 2.3.1.2 Configuration (only needs to be set once; stored in NVM)

```
bool ConfigureIOPins(mask)
bool fnRxLED (On/Off, Toggle/Blink, 100/
200mS)
bool fnTxLED (On/Off, Toggle/Blink, 100/
200mS)
bool fnHardwareFlowControl (On/Off)
bool fnUSBcfg(on/off)
bool fnSuspend (on/off)
bool SetBaudRate (baudrate)
bool ConfigureAll (TRISmask, RxLED, TxLED,
RxTGL, TxTGL, LEDX, FLOW, USBCFG, SSPND,
BaudRate)
```

#### 2.3.1.3 I/O Control

```
bool ClearPin(pinnumber)
bool ReadPin(pinnumber)
bool SetPort (portValue)
bool ReadPort(*portValue)
bool WriteEEPROM (Address, Data)
bool ReadEEPROM (Address)
```

#### 2.3.1.4 Summary

```
Summary:
SimpleIOClass::InitMCP2200 (unsigned int
VendorID, unsigned int ProductID)
bool SimpleIOClass::ConfigureMCP2200
(unsigned char IOMap,
unsigned long BaudRate,
unsigned int  RxLED,
unsigned int  TxLED,
bool          Hardware Flow Control,
bool          USBCFG pin function,
bool          Suspend pin function)
bool SimpleIOClass::SetPin(unsigned int pin)
bool SimpleIOClass::ClearPin(unsigned int
pin)
bool SimpleIOClass::ReadPin(unsigned int pin,
unsigned int *returnvalue)
bool SimpleIOClass::WritePort(unsigned int
value)
bool SimpleIOClass::ReadPort(unsigned int
*returnvalue)
```

While ConfigureMCP2200 configures the device with one call, it may also be configured one parameter at a time:

```
bool SimpleIOClass::fnRxLED (unsigned int
mode)
bool SimpleIOClass::fnTxLED (unsigned int
mode)
bool SimpleIOClass::fnHardwareFlowControl
(unsigned int onOff)
bool SimpleIOClass::fnUSBCFG (unsigned int
onOff)
bool SimpleIOClass::fnSuspend (unsigned int
onOff)
bool SimpleIOClass::fnSetBaudRate (unsigned
long BaudRateParam)
bool SimpleIOClass::ConfigureIO (unsigned
char IOMap)
```

```
Constants:
const unsigned int OFF = 0;
const unsigned int ON = 1;
const unsigned int TOGGLE = 3;
const unsigned int BLINKSLOW = 4;
const unsigned int BLINKFAST = 5;
```

#### 2.3.1.5 InitMCP2200

```
SimpleIOClass::InitMCP2200 (unsigned int
VendorID, unsigned int ProductID)
```

Configures the Simple IO class for a specific Vendor and product ID.

```
Parameters:
Vendor ID - Assigned by USB IF (www.usb.org)
    Product ID - Assigned by the Vendor ID
Holder
```

```
Returns:
none
```

```
  Example:
  InitMCP2200 (0x04D8, 0x00DF);
```

#### 2.3.1.6 ConfigureMCP2200

```
bool SimpleIOClass::ConfigureMCP2200
(unsigned char IOMap,
unsigned long BaudRate,
unsigned int  RxLED,
unsigned int  TxLED,
bool          Hardware Flow Control,
bool          USBCFG pin function,
bool          Suspend pin function)
```

Configures the device's default baudrate, GPIO configuration and pin functions.  Other functions set each parameter one at a time. This configures the part in one call.

```
Precondition:
The Vendor and Product ID must have been
specified by SimpleIOInit.
```

Parameters:
IOMap - A byte which represents the input/
output state of the pins (each bit may be
either a 1 for input, and 0 for output.
Baudrate -
RxLED & TxLED - constant OFF, TOGGLE,
BLINKSLOW, BLINKFAST
Boolean - HWFlow control, USBCFG, Suspend

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

```
  Example:
  <code>

    if (SimpleIOClass::ConfigureMCP2200(0x43,
9600, BLINKSLOW, BLINKFAST, false, false,
false) == SUCCESS)
        lblStatusBar->Text = "Success";
    else
        lblStatusBar->Text = "Invalid command
"
  </code>
```

### 2.3.1.7 fnRxLED

bool SimpleIOClass::fnRxLED (unsigned int
mode)

Summary:
Configures the RxLED pin function.

Description:
Sets the

Precondition:
The Vendor and Product ID must have been
specified by SimpleIOInit.

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

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

Error code logged in LastError.

```
  Example:
  <code>

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

### 2.3.1.8 fnTxLED

bool SimpleIOClass::fnTxLED (unsigned int
mode)

Summary:
Configures the TxLED pin function.

Description:
Sets the

Precondition:
The Vendor and Product ID must have been
specified by SimpleIOInit.

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

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

Error code logged in LastError.

```
  Example:
  <code>

    if (SimpleIOClass::fnTxLED(BLINKFAST) ==
SUCCESS)
        lblStatusBar->Text = "Success";
    else
        lblStatusBar->Text = "Invalid command
" + SimpleIOClass::LastError;
  </code>
```

### 2.3.1.9 fnHardwareFlowControl

bool SimpleIOClass::fnHardwareFlowControl
(unsigned int onOff)

Summary:
Configures the device.

Description:
Sets the

Precondition:
The Vendor and Product ID must have been
specified by SimpleIOInit.

Parameters:
IOMap - An array of configuration parameters,
one byte per IO Line

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

Example:
```
  <code>
if
(SimpleIOClass::ConfigureMCP2200(OutputPacket
Buffer) == SUCCESS)
lblStatusBar->Text = "Success";
    else
        lblStatusBar->Text = "Invalid command
" + SimpleIOClass::LastError;
  </code>
```

### 2.3.1.10  fnUSBCFG

```
bool SimpleIOClass::fnUSBCFG (unsigned int
onOff)
```

Summary:
Configures the USBCFG pin function.

Precondition:
The Vendor and Product ID must have been
specified by SimpleIOInit.

Parameters:
onOff (constant): ON or OFF.

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

Example:
```
  <code>

if
(SimpleIOClass::ConfigureMCP2200(OutputPacket
Buffer) == SUCCESS)
        lblStatusBar->Text = "Success";
    else
        lblStatusBar->Text = "Invalid command
" + SimpleIOClass::LastError;
  </code>
```

Remarks:
Error code is returned in LastError

### 2.3.1.11  fnSuspend

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

Summary:
Configures the SSPND function

Precondition:
The Vendor and Product ID must have been
specified by SimpleIOInit.

Parameters:
onOff (constant): ON or OFF.

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

Example:
```
  <code>

    if
(SimpleIOClass::ConfigureMCP2200(OutputPacket
Buffer) == SUCCESS)
        lblStatusBar->Text = "Success";
    else
        lblStatusBar->Text = "Invalid command
" + SimpleIOClass::LastError;
  </code>
```

Remarks:
Error code is returned in LastError

### 2.3.1.12  fnSetBaudRate

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

Summary:
Configures the device.

Precondition:
    The Vendor and Product ID must have been
specified by SimpleIOInit.

Parameters:
    IOMap - An array of configuration
parameters, one byte per IO Line

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

Example:
```
  <code>

    if
(SimpleIOClass::ConfigureMCP2200(OutputPacket
Buffer) == SUCCESS)
        lblStatusBar->Text = "Success";
    else
        lblStatusBar->Text = "Invalid command
" + SimpleIOClass::LastError;
  </code>
```

  Remarks:
    Error code is returned in LastError

### 2.3.1.13  ConfigureIO

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

Summary:
Configures the IO pins for Digital Input,
Digital Output

Description:
IO Pins can be configured as Digital Input,
Digital Output

Precondition:
The Vendor and Product ID must have been
specified by SimpleIOInit.

Parameters:
IOMap - one byte, with each bit corresponding
to each GP pin.  0 for output, 1 for input.

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

Example:
```
  <code>

    if
(SimpleIOClass::ConfigureGPIO(OutputPacketBuf
fer) == SUCCESS)
        lblStatusBar->Text = "Success";
    else
        lblStatusBar->Text = "Invalid command
" + SimpleIOClass::LastError;
  </code>
```

### 2.3.1.14    SetPin

bool SimpleIOClass::SetPin(unsigned int pin)

Summary:
Sets the specified pin.

Description:
Sets the specified pin to one.

Precondition:
Must have previously been configured as an
output via a ConfigureGPIO call.

Parameters:
pin - The pin number to set (0-7)

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

Example:
```
  <code>
    if (SimpleIOClass::SetPin (2))
    {
        lblStatusBar->Text = "Success";
    }
    else
        lblStatusBar->Text = "Invalid command
" +  SimpleIOClass::LastError;
  </code>
```

  Remarks:
    none

### 2.3.1.15    ClearPin

bool SimpleIOClass::ClearPin(unsigned int
pin)

Summary:
Clears the specified pin.

Description:
Sets the specified pin to zero.

Precondition:
Must have previously been configured as an
output via a ConfigureGPIO call.

Parameters:
pin - The pin number to set (0-7)

Returns:
Function returns true if the transmission is
successful, returns False if there the
transmission fails.

Example:
```
  <code>
    if (SimpleIOClass::ClearPin (2))
    {
        lblStatusBar->Text = "Success";
    }
    else
        lblStatusBar->Text = "Invalid command
" +  SimpleIOClass::LastError;
  </code>
```

  Remarks:
    none

### 2.3.1.16    ReadPin

bool SimpleIOClass::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 Digital Input, the return value
will be either 0 or 1.  If the pin has been
configured as Analog Input, the pin will be
read by the ADC and return a 10 bit value,
right justified.

Precondition:
Must have previously been configured as an
input via a ConfigureGPIO call.

Parameters:
pin - The pin number to set (0-7)
returnvalue - the value read on the pin (0 or
1)

Returns:
    true if the pin was successfully read.
    false if the pin was not read (not configued as an input).

Example:
```
  <code>
    unsigned int rv;
    if (SimpleIOClass::ReadGPIOn (0, &rv))
    {
        lblStatusBar->Text = "Success";
    }
    else
        lblStatusBar->Text = "Invalid command
" +  SimpleIOClass::LastError;
  </code>
```

### 2.3.1.17    WritePort

```
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 at once instead of one-at-a-time.

Precondition:
Must have previously been configured as an output via a ConfigureGPIO call.

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

Returns:
Function returns true if the transmission is successful
returns False if there the transmission fails.

```
  Example:
  <code>
    if (SimpleIOClass::WritePort (0x5A))
    {
        lblStatusBar->Text = "Success";
    }
    else
        lblStatusBar->Text = "Invalid command
" +  SimpleIOClass::LastError;
  </code>
```

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

### 2.3.1.18    ReadPort

```
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 at once instead of one-at-a-time.

Precondition:
Must have previously been configured as an input via a ConfigureGPIO call.

Parameters:
returnvalue - the value read on the port.

Returns:
    Function returns true if the read is successful
    returns False if there the transmission fails.

Example:
```
  <code>
unsigned int rv;
    if (SimpleIOClass::ReadGPIOPort (&rv))
    {
        lblStatusBar->Text = "Success";
    }
    else
        lblStatusBar->Text = "Invalid command
" +  SimpleIOClass::LastError;
  </code>
```

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

## 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 $V_{DD}$ with respect to $V_{SS}$, PIC18F ....................................................................................-0.3V to +6.0V

Voltage on $V_{DD}$ with respect to $V_{SS}$, PIC18LF ................................................................................-0.3V to +4.0V

Voltage on $\overline{MCLR}$ with respect to $V_{SS}$ ...........................................................................................-0.3V to +9.0V

Voltage on $V_{USB}$ pin with respect to $V_{SS}$ ..........................................................................................-0.3V to +4.0V

Voltage on D+ and D- pins with respect to $V_{SS}$ ......................................................................-0.3V to ($V_{USB}$ + 0.3V)

Voltage on all other pins with respect to $V_{SS}$ ..........................................................................-0.3V to ($V_{DD}$ + 0.3V)

Total power dissipation[(1)] .................................................................................................................800 mW

Maximum current out of $V_{SS}$ pin .......................................................................................................95 mA

Maximum current into $V_{DD}$ pin .........................................................................................................95 mA

Clamp current, $I_K$ ($V_{PIN}$ < 0 or $V_{PIN}$ > $V_{DD}$)................................................................................$\pm$ 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:**    Power dissipation is calculated as follows: $P_{DIS} = V_{DD} \times \{I_{DD} - \sum I_{OH}\} + \sum \{(V_{DD} - V_{OH}) \times I_{OH}\} + \sum(V_{OL} \times I_{OL})$.

  **2:**    $V_{USB}$ must always be $\leq V_{DD}$ + 0.3V

---

**† 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.

---

# MCP2200

## 3.1 DC CHARACTERISTICS

| DC Characteristics | | Operating Conditions (unless otherwise indicated): 3.0V ≤ VDD ≤ 5.5V at -40°C ≤ TA ≤ +85°C (I-Temp) | | | | | |
|---|---|---|---|---|---|---|---|
| Param No. | Characteristic | Sym | Min | Typ | Max | Units | Conditions |
| D001 | Supply Voltage | VDD | 3.0 | — | 5.5 | V | |
| | Power-on Reset Release Voltage | VPOR | | 1.6 | | V | |
| | Power-on Reset Rearm Voltage | | | 0.8 | | V | |
| D003 | VDD Rise Rate to Ensure Power-on Reset | SVDD | 0.05 | — | — | V/ms | Design guidance only Not tested |
| D004 | Supply Current | IDD | | | | | FOSC = 12 MHz, (330 nF on VUSB) |
| | VDD = 3.0V | | — | 10 | 12 | mA | |
| | VDD = 5.0V | | — | 13 | 15 | mA | |
| D005 | Standby current | IDDS | — | 9 | — | µA | |
| | **Input Low-Voltage** | | | | | | |
| D031 | Schmitt Trigger (GPIO) | VIL | — | — | 0.2 VDD | V | 3.0V ≤ VDD ≤ 5.5V |
| | TTL (CTS pin) | | — | — | 0.8 | | 4.5V ≤ VDD ≤ 5.5V |
| | **Input High-Voltage** | | | | | | |
| D041 | Schmitt Trigger (GPIO) | VIH | 0.8 VDD | — | VDD | V | 3.0V ≤ VDD ≤ 5.5V |
| | TTL (RTS pin) | | 2.0 | — | VDD | | 4.5V ≤ VDD ≤ 5.5V |
| | **Input Leakage Current** | | | | | | |
| D060 | GPIO, CTS | IIL | — | ±50 | ±100 | nA | VSS ≤ VPIN ≤ VDD, pin at Hi-Z |
| | RST | | | ±50 | ±200 | | |
| | OSC1 | | | ±50 | ±100 | | |
| | **Output Low-Voltage** | | | | | | |
| D080 | GPIO | VOL | — | — | 0.6 | V | IOL = 8.0 mA, VDD = 5.0V |
| | | | — | — | 0.6 | | IOL = 6.0 mA, VDD = 3.3V |
| | **Output High-Voltage** | | | | | | |
| D090 | GPIO | VOH | VDD – 0.7 | — | — | V | IOH = -3.5 mA, VDD = 5.0V |
| | | | VDD – 0.7 | — | — | | IOH = -3.0 mA, VDD = 3.3V |
| | **Capacitive Loading Specs on Output Pins** | | | | | | |
| D101 | OSC2 | COSC2 | — | — | 15 | pF | **Note 1** |
| D102 | GPIO | CIO | — | — | 50 | pF | **Note 1** |

**Note 1:** This parameter is characterized, but not tested.

**FIGURE 3-1:** POR AND POR REARM WITH SLOW RISING $V_{DD}$



**Note 1:** When NPOR is low, the device is held in Reset.
2: $T_{POR}$ 1 μs typical.
3: $T_{VLOW}$ 2.7 μs typical.
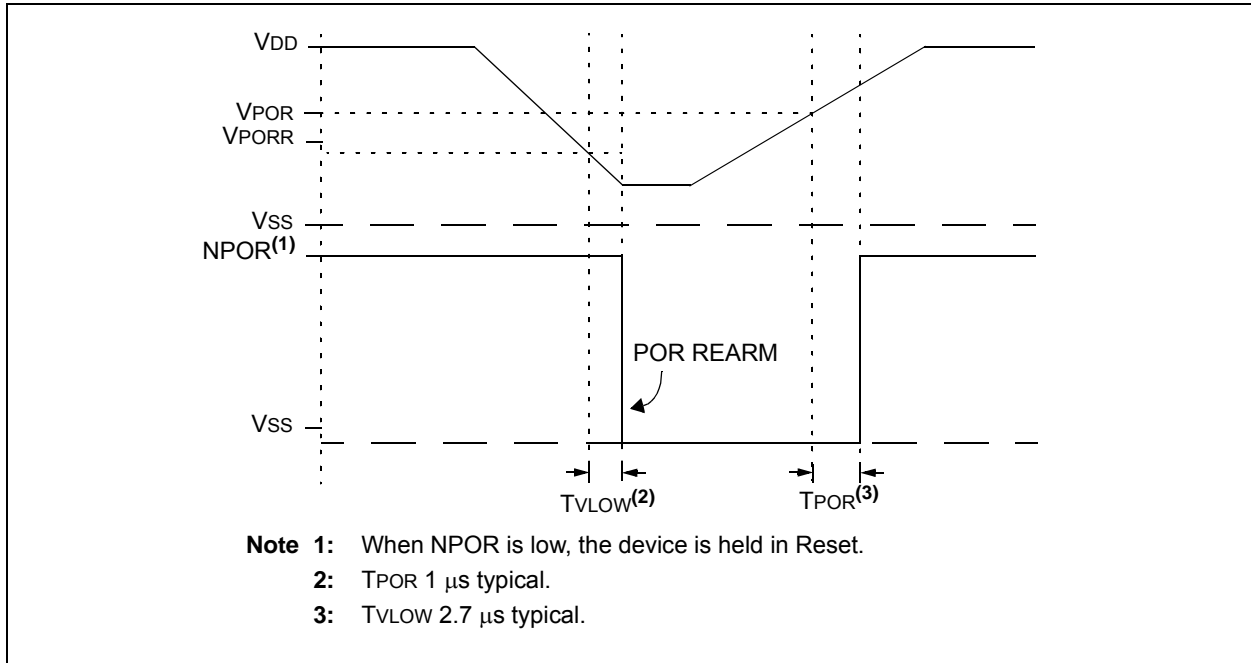
**TABLE 3-1:** USB MODULE SPECIFICATIONS

| DC Characteristics | | Operating Conditions (unless otherwise indicated):<br>$3.0V \leq V_{DD} \leq 5.5V$ at $-40°C \leq T_A \leq +85°C$ (I-Temp) | | | | | |
|---|---|---|---|---|---|---|---|
| Param No. | Characteristic | Sym | Min | Typ | Max | Units | Conditions |
| D313 | USB Voltage | $V_{USB}$ | 3.0 | — | 3.6 | V | Voltage on $V_{USB}$ pin must be in this range for proper USB operation |
| D314 | Input Leakage on Pin | $I_{IL}$ | — | — | ± 1 | μA | $V_{SS} \leq V_{PIN} \leq V_{DD}$ pin at high-impedance |
| D315 | Input Low Voltage for USB Buffer | $V_{ILUSB}$ | — | — | 0.8 | V | For $V_{USB}$ range |
| D316 | Input High Voltage for USB Buffer | $V_{IHUSB}$ | 2.0 | — | — | V | For $V_{USB}$ range |
| D318 | Differential Input Sensitivity | $V_{DIFS}$ | — | — | 0.2 | V | The difference between D+ and D- must exceed this value while $V_{CM}$ is met |
| D319 | Differential Common Mode Range | $V_{CM}$ | 0.8 | — | 2.5 | V | |
| D320 | Driver Output Impedance[1] | $Z_{OUT}$ | 28 | — | 44 | Ω | |
| D321 | Voltage Output Low | $V_{OL}$ | 0.0 | — | 0.3 | V | 1.5 kΩ load connected to 3.6V |
| D322 | Voltage Output High | $V_{OH}$ | 2.8 | — | 3.6 | V | 1.5 kΩ load connected to ground |

**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.

# MCP2200

**TABLE 3-2: THERMAL CONSIDERATIONS**

| **Standard Operating Conditions (unless otherwise stated)** |
|||||||

**Standard Operating Conditions (unless otherwise stated)**
Operating temperature -40°C $\leq$ TA $\leq$ +85°C (I-Temp)

| Param No. | Sym | Characteristic | Typ | Units | Conditions |
|---|---|---|---|---|---|
| TH01 | $\theta_{JA}$ | Thermal Resistance Junction to Ambient | 85.2 | °C/W | 20-pin SOIC package |
| | | | 108.1 | °C/W | 20-pin SSOP package |
| | | | TBD | °C/W | 20-pin QFN 5x5mm package |
| TH02 | $\theta_{JC}$ | Thermal Resistance Junction to Case | 24 | °C/W | 20-pin SOIC package |
| | | | 24 | °C/W | 20-pin SSOP package |
| | | | 24 | °C/W | 20-pin QFN 6x6mm package |
| TH03 | $T_{JMAX}$ | Maximum Junction Temperature | 150 | °C | |
| TH04 | PD | Power Dissipation | — | W | PD = $P_{INTERNAL}$ + $P_{I/O}$ |
| TH05 | $P_{INTERNAL}$ | Internal Power Dissipation | — | W | $P_{INTERNAL}$ = $I_{DD}$ x $V_{DD}$[1] |
| TH06 | $P_{I/O}$ | I/O Power Dissipation | — | W | $P_{I/O}$ = $\Sigma$ ($I_{OL}$ * $V_{OL}$) + $\Sigma$ ($I_{OH}$ * ($V_{DD}$ – $V_{OH}$)) |
| TH07 | $P_{DER}$ | Derated Power | — | W | $P_{DER}$ = $PD_{MAX}$ ($T_J$ - $T_A$)/$\theta_{JA}$[2,3] |

**Legend:** TBD = To Be Determined.

**Note 1:** $I_{DD}$ is the current to run the chip alone without driving any load on the output pins.

   **2:** $T_A$ = Ambient Temperature.

   **3:** $T_J$ = 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 | |
|---|---|---|---|
| T | | | |
| F | Frequency | T | Time |
| E | Error | | |

Lowercase letters (pp) and their meanings:

| pp | | | |
|---|---|---|---|
| io | Input or Output pin | osc | Oscillator |
| rx | Receive | tx | Transmit |
| bitclk | RX/TX BITCLK | RST | Reset |
| drt | Device Reset Timer | | |

Uppercase letters and their meanings:

| S | | | |
|---|---|---|---|
| F | Fall | P | Period |
| H | High | R | Rise |
| I | Invalid (high-impedance) | V | Valid |
| L | Low | Z | High-impedance |

### 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**

| AC CHARACTERISTICS | **Standard Operating Conditions (unless otherwise stated)**<br>Operating temperature -40°C ≤ $T_A$ ≤ +85°C<br>Operating voltage $V_{DD}$ range as described in DC spec **Section 3.1 "DC Characteristics"**. |
|---|---|

**FIGURE 3-2:    LOAD CONDITIONS FOR DEVICE TIMING SPECIFICATIONS**
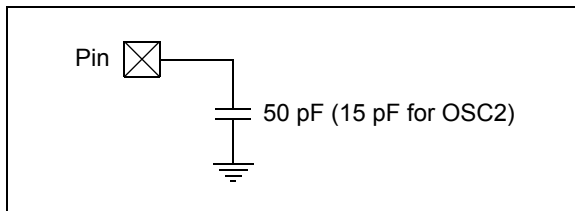
### 3.2.3    TIMING DIAGRAMS AND SPECIFICATIONS

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

| **Standard Operating Conditions (unless otherwise stated)** Operating Temperature -40°C ≤ TA ≤ +85°C | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Param No.** | **Sym** | **Characteristic** | **Min** | **Typ†** | **Max** | **Units** | **Conditions** |
| 30 | TRST | $\overline{\text{MCLR}}$ Pulse Width (low) | 2 | — | — | µs | |
| 31 | TPWRT | Power-up timer | 40 | 65 | 140 | ms | |
| 32 | TOST | Oscillator startup time | — | 1024 | — | TOST | |

　　\*　These parameters are characterized but not tested.

　　†　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

20-Lead QFN

```
XXXXX
XXXXXX
XXXXXX
YWWNNN
```

Example

```
       Ⓜ
MCP2200
I/MQ ⓔ3
1004256
```

20-Lead SOIC

```
XXXXXXXXXXXXX
XXXXXXXXXXXXX
XXXXXXXXXXXXX
     Ⓜ YYWWNNN
●
```

Example:

```
MCP2200
I/SO ⓔ3
1004256
     Ⓜ
●
```

20-Lead SSOP

```
XXXXXXXXXXX
XXXXXXXXXXX
    Ⓜ YYWWNNN
●
```

Example:

```
MCP2200
I/SS ⓔ3
1004256
   Ⓜ
●
```
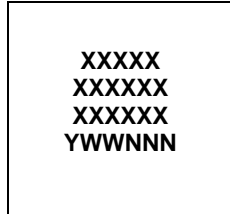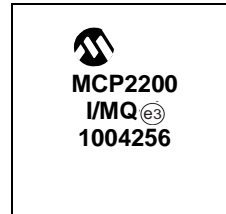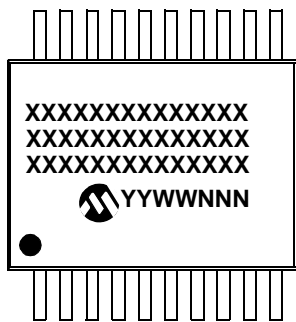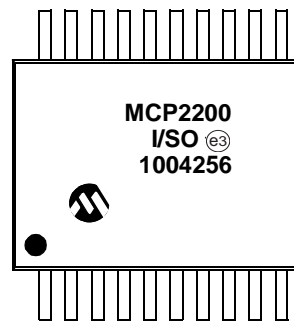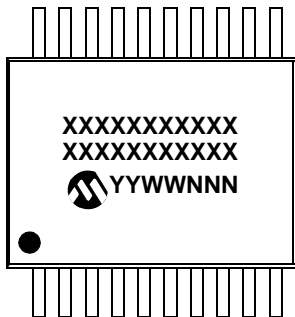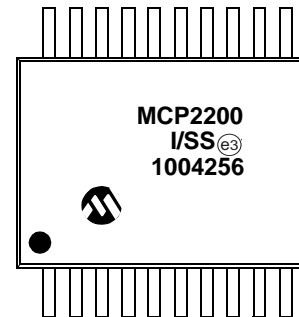
| **Legend:** | XX...X | Customer-specific information |
| --- | --- | --- |
| | Y | Year code (last digit of calendar year) |
| | YY | Year code (last 2 digits of calendar year) |
| | WW | Week code (week of January 1 is week '01') |
| | NNN | Alphanumeric traceability code |
| | ⓔ3 | Pb-free JEDEC designator for Matte Tin (Sn) |
| | * | This package is Pb-free. The Pb-free JEDEC designator (ⓔ3) 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) – 5x5x0.9 mm Body [QFN]

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

TOP VIEW

BOTTOM VIEW

NOTE 1
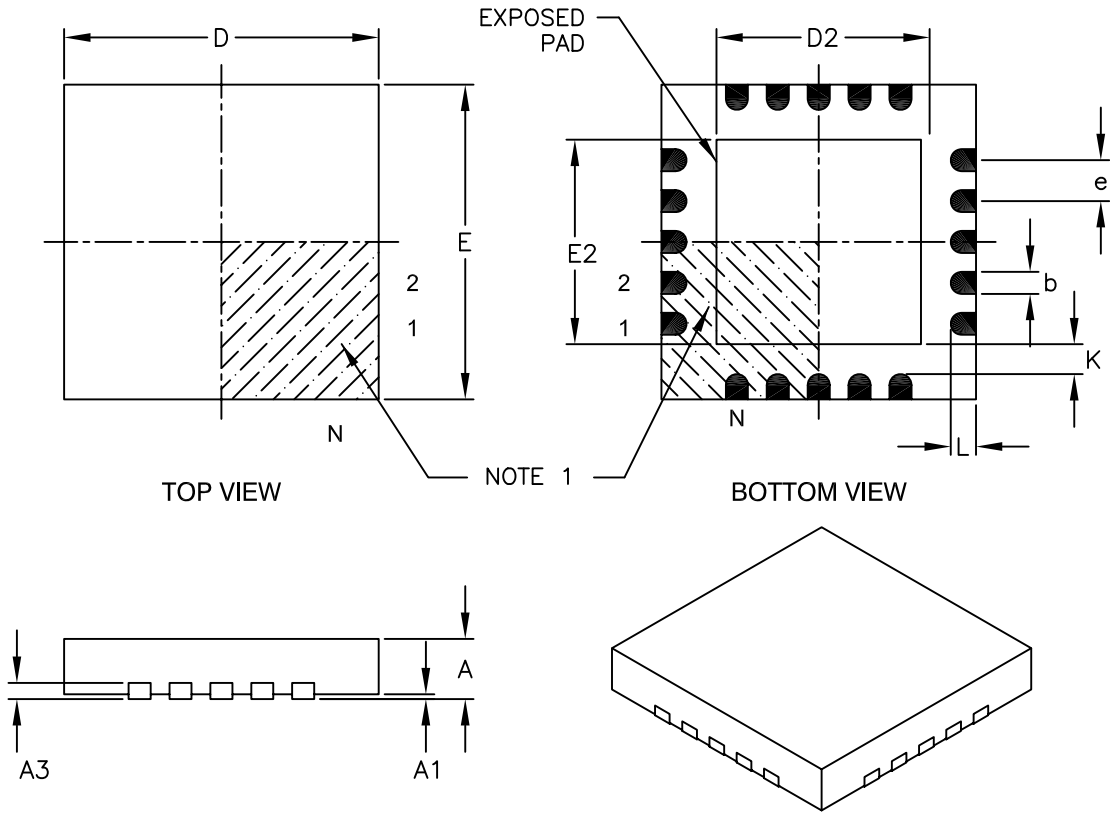
| | Units | MILLIMETERS | | |
|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX |
| Number of Pins | N | | 20 | |
| Pitch | e | | 0.65 BSC | |
| Overall Height | A | 0.80 | 0.90 | 1.00 |
| Standoff | A1 | 0.00 | 0.02 | 0.05 |
| Contact Thickness | A3 | | 0.20 REF | |
| Overall Width | E | | 5.00 BSC | |
| Exposed Pad Width | E2 | 3.15 | 3.25 | 3.35 |
| Overall Length | D | | 5.00 BSC | |
| Exposed Pad Length | D2 | 3.15 | 3.25 | 3.35 |
| Contact Width | b | 0.25 | 0.30 | 0.35 |
| Contact Length | L | 0.35 | 0.40 | 0.45 |
| Contact-to-Exposed Pad | K | 0.20 | - | - |

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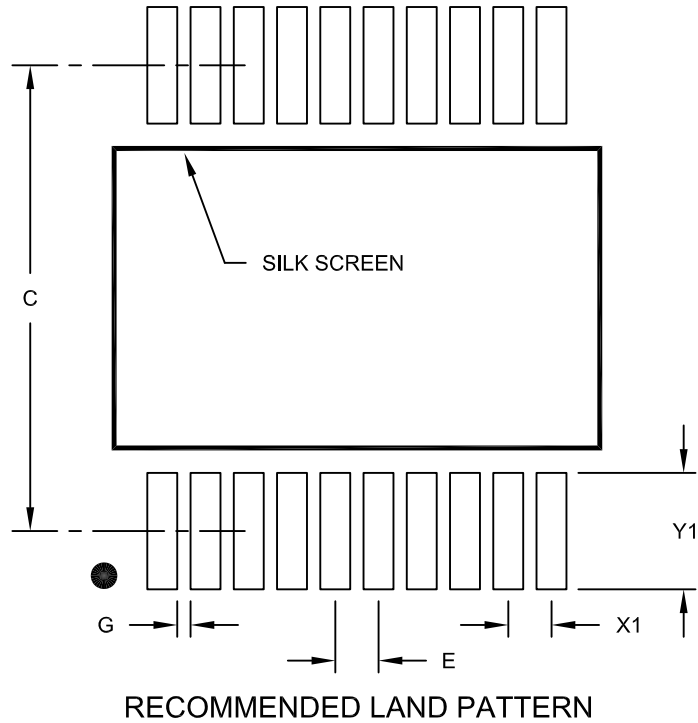3. Dimensioning and tolerancing per ASME Y14.5M.
    BSC: Basic Dimension. Theoretically exact value shown without tolerances.
    REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-139B

20-Lead Plastic Quad Flat, No Lead Package (MQ) - 5x5 mm Body [QFN]
With 0.40mm Contact Length

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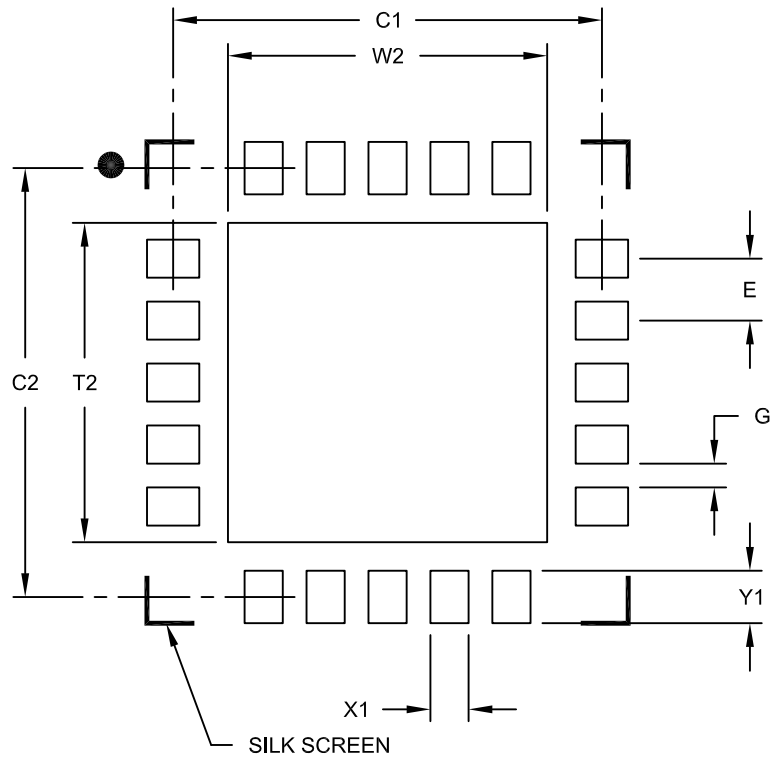
RECOMMENDED LAND PATTERN

| | Units | MILLIMETERS | | |
|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX |
| Contact Pitch | E | 0.65 BSC | | |
| Optional Center Pad Width | W2 | | | 3.35 |
| Optional Center Pad Length | T2 | | | 3.35 |
| Contact Pad Spacing | C1 | | 4.50 | |
| Contact Pad Spacing | C2 | | 4.50 | |
| Contact Pad Width (X20) | X1 | | | 0.40 |
| Contact Pad Length (X20) | Y1 | | | 0.55 |
| Distance Between Pads | G | 0.20 | | |

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

Microchip Technology Drawing No. C04-2139A

## 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
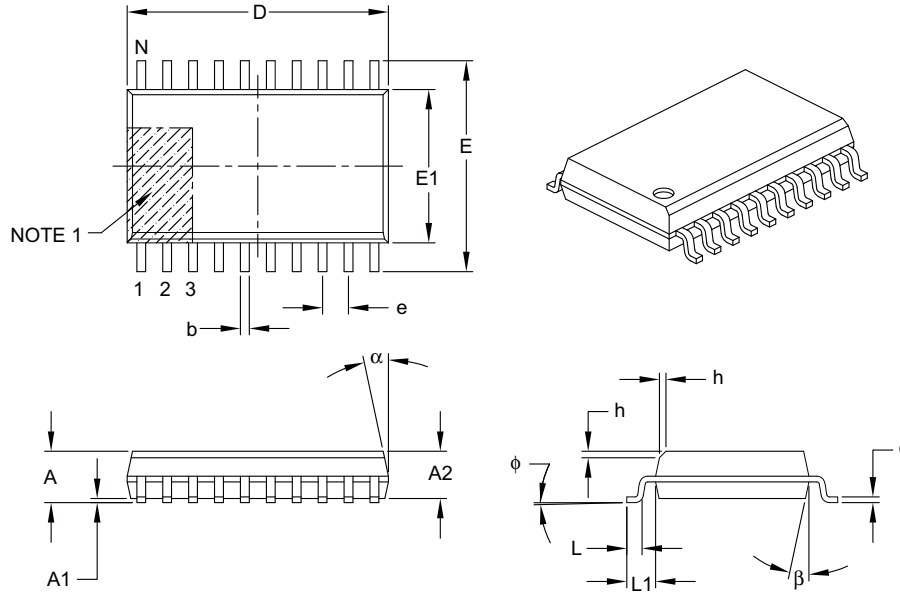


| Units | | MILLIMETERS | | |
|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX |
| Number of Pins | N | | 20 | |
| Pitch | e | | 1.27 BSC | |
| Overall Height | A | – | – | 2.65 |
| Molded Package Thickness | A2 | 2.05 | – | – |
| Standoff § | A1 | 0.10 | – | 0.30 |
| Overall Width | E | | 10.30 BSC | |
| Molded Package Width | E1 | | 7.50 BSC | |
| Overall Length | D | | 12.80 BSC | |
| Chamfer (optional) | h | 0.25 | – | 0.75 |
| Foot Length | L | 0.40 | – | 1.27 |
| Footprint | L1 | | 1.40 REF | |
| Foot Angle | φ | 0° | – | 8° |
| Lead Thickness | c | 0.20 | – | 0.33 |
| Lead Width | b | 0.31 | – | 0.51 |
| Mold Draft Angle Top | α | 5° | – | 15° |
| Mold Draft Angle Bottom | β | 5° | – | 15° |

**Notes:**

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 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.

Microchip Technology Drawing C04-094B

20-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body  [SOIC]

RECOMMENDED LAND PATTERN

| | Units | | MILLIMETERS | | |
|---|---|---|---|---|---|
| | Dimension Limits | | MIN | NOM | MAX |
| Contact Pitch | E | | | 1.27 BSC | |
| Contact Pad Spacing | C | | | 9.40 | |
| Contact Pad Width (X20) | X | | | | 0.60 |
| Contact Pad Length (X20) | Y | | | | 1.95 |
| Distance Between Pads | Gx | | 0.67 | | |
| Distance Between Pads | G | | 7.45 | | |

Notes:
1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2094A

# MCP2200

## 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
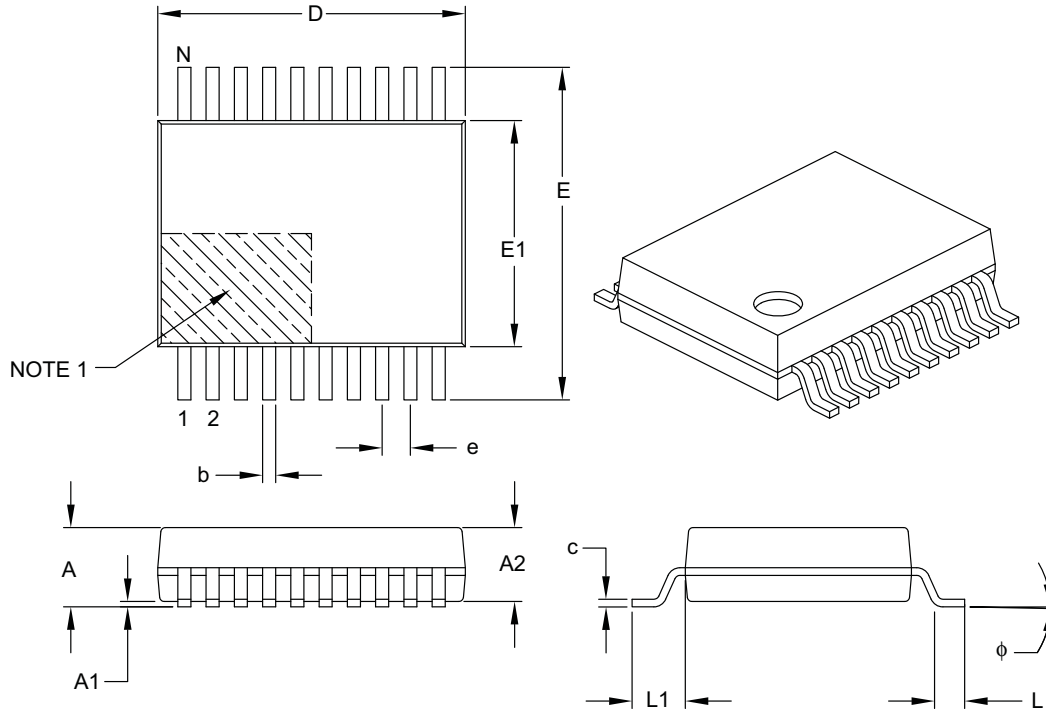
| | Units | | MILLIMETERS | |
|---|---|---|---|---|
| | Dimension Limits | MIN | NOM | MAX |
| Number of Pins | N | | 20 | |
| Pitch | e | | 0.65 BSC | |
| Overall Height | A | – | – | 2.00 |
| Molded Package Thickness | A2 | 1.65 | 1.75 | 1.85 |
| Standoff | A1 | 0.05 | – | – |
| Overall Width | E | 7.40 | 7.80 | 8.20 |
| Molded Package Width | E1 | 5.00 | 5.30 | 5.60 |
| Overall Length | D | 6.90 | 7.20 | 7.50 |
| Foot Length | L | 0.55 | 0.75 | 0.95 |
| Footprint | L1 | | 1.25 REF | |
| Lead Thickness | c | 0.09 | – | 0.25 |
| Foot Angle | φ | 0° | 4° | 8° |
| Lead Width | b | 0.22 | – | 0.38 |

**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

| | Units | MILLIMETERS | | |
|---|---|---|---|---|
| Dimension Limits | | MIN | NOM | MAX |
| Contact Pitch | E | | 0.65 BSC | |
| Contact Pad Spacing | C | | 7.20 | |
| Contact Pad Width (X20) | X1 | | | 0.45 |
| Contact Pad Length (X20) | Y1 | | | 1.75 |
| Distance Between Pads | G | 0.20 | | |

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

Microchip Technology Drawing No. C04-2072A

**NOTES:**

## APPENDIX A: REVISION HISTORY

### Revision A (March 2010)

• Original Release of this Document.

**NOTES:**

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.      X      /XX

**Device**    **Temperature**    **Package**
            **Range**

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

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

| Package | MQ | = | Plastic Quad Flat, No Lead Package 5x5x0.9 mm Body (QFN), 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 QFN Package.

b)   MCP2200T- I/MQ:   Tape and Reel, Industrial temperature, 20LD QFN Package.

a)   MCP2200- I/SO:   Industrial temperature, 20LD SOIC Package.

b)   MCP2200T- I/SO:   Tape and Reel, Industrial temperature, 20LD SOIC Package.

a)   MCP2200- I/SS:   Industrial temperature, 20LD SSOP Package.

b)   MCP2200T- I/SS:   Tape and Reel, Industrial temperature, 20LD SSOP Package.

**NOTES:**

QUALITY MANAGEMENT SYSTEM
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