Development Hardware

Target Board and In-circuit Debugger
Microchip PICDEM 2 Plus

Target Board
PICDEM 2 Plus Demo Board
PICDEM 2 Plus Demo Board

2010 Version
- Very similar to 2002 (green/red) version
- Changed uC connectors
- New (PICKIT) connectors
- Many surface mount components
PICDEM 2 Plus Demo Board

Power
- 12V Unreg to LM340
- 9V Battery
- Power-on LED
PICDEM 2 Plus Demo Board

ICSP/ICD (Debug) Port

#MCLR Button (Reset)
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**Processor**
- 40 Pin
- 28 Pin
- 18 Pin

**Prototype**
- All ports brought to SIL headers
- Prototype area with +5V, +0V
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Clocking

- 4MHz Packaged Oscillator (use EC)
- XTAL
- RC (J7 enables) (use RC)
- Watch Xtal for T1/T3
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Inputs

Potentiometer
- Analog RA0

Push Buttons
- Digital RA4
- Digital RB0
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**Outputs**

- **LEDs**
  - RB3 : RB0
  - J6 enables

- **16 x 2 LCD**
  - Control - RA1 : RA3
  - Data - RD0 : RD3

- **Piezo Buzzer**
- RC2
- J9 enables
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**USART**
- MAX232, D9F

**I^2C Devices**
- Temperature Sensor
- 8x256k serial EEPROM
Clocking

Three possible clock sources

- **4MHz packaged oscillator**
  - Remove J7
  - Use `CONFIG OSC=EC`

- **Crystal oscillator**
  - Unpopulated on board
  - Remove J7
  - Use `CONFIG OSC=XT` *(or OSC HS or OSC PLL)*

- **RC oscillator**
  - Fit J7
  - Use `CONFIG OSC=RC`
Inputs

- **Potentiometer**
  - Analog Input Channel RA0
    - DIP40 Pin 2

- **Push Buttons**
  - Digital Input RA4
    - DIP40 Pin 6
    - RA4 is also T0CKI
  - Digital Input RB0
    - DIP40 Pin 33
    - RB0 is also INTO
Outputs - LEDs

Four Red LEDs
- RB3 (pin 36)
  - Also CCP2
- RB2 (pin 35)
  - Also INT2
- RB1 (pin 34)
  - Also INT1
- RB0 (pin 33)
  - Also INT0

- Each LED has 470R series resistor
- Jumper J6 enables all LEDs by connecting (common) cathodes to +0V
Outputs – 2 Line x 16 Character LCD

COG (Chip On Glass), compatible with Industry standard Hitachi HD44780 controller
- Operates in 4-bit data bus mode

Three Control Bits
- RA1 (pin 3)
  - RS (actually C/#D) on LCD
- RA2 (pin 4)
  - R/#W on LCD
  - [This pin also $v_{REF-}$ for A/D]
- RA3 (pin 5)
  - E on LCD – latches on falling edge
  - [This pin also $v_{REF+}$ for A/D]

Four Data Bits
- RD0 (pin 19)
  - Bit D4 on LCD
  - [This pin also PSP0]
- RD1 (pin 20)
  - Bit D5 on LCD
  - [This pin also PSP1]
- RD2 (pin 21)
  - Bit D6 on LCD
  - [This pin also PSP2]
- RD3 (pin 22)
  - Bit D7 on LCD
  - [This pin also PSP3]
Outputs – Piezo Buzzer

- Driven by a BJT from RC2 (pin 17)
- RC2 is also CCP1, so easy to generate tones via PWM...
- Enabled by closing jumper J9
Serial Devices - UART

USART
Transmit – RC6/TX (pin 25)
- Connects to D9F pin 2
- [This pin also UART synch. clock, CK]

Receive – RC7/RX (pin 26)
- Connects to D9F pin 3
- [This pin also UART synch. data, DT]

- Uses MAX232 RS323 Driver
- +5V supply only: ±10V from charge pump driven boost converters
- D9 pin 4 looped back to pin 6 so that RTS output asserts CTS input on board
**I²C Devices**

**Temperature Sensor U5**
- Microchip TC74
- Accurate to about 2°C
- Address = 10010101 or 0x9A
  [Error in PICDEM2 Manual]

Both U4 and U5 use
- **I²C clock** - **SCL** (pin 18)
  - [This pin also RC3, SCK]
- **I²C data I/O** - **SDA** (pin 23)
  - [This pin also RC4, SDI]

**8x256K serial EEPROM U4**
- Microchip 27LC256
- 8-pin device
- 4 address pins, so that 8 can reside on one bus ⇒ 2M of addressable EEPROM
Or you can make your own...
Edward’s Breadboard Board
Kirsty’s Plywood Board
Microchip ICD 3

In Circuit Debugger
ICD 3 = In-Circuit Debugger 3
ICD 3 and PICDEM 2 Connections

NEVER
- Disconnect USB with PICDEM Board powered

NEVER
- Inject signals into PICDEM when it is not powered
Power-Up Sequence

- Power-up ICD 3
  - We will always power the ICD 3 through the USB cable
  - NEVER CONNECT ICD 3 TO POWERED BOARD IF ICD 3 IS UNPOWERED

- Power-up PICDEM 2 Plus board
  - Connect +12V Regulated or Unregulated supply to socket J2
  - Positive voltage on centre pin!!
How ICD 3 Works: Connections

ICD 3 controls these lines:
- PGC (Programming Clock)
- PGD (Programming Data)
- VPP/#MCLR

Also supplies
- \(V_{SS}\), \(V_{DD}\)

NOTE:
- Buffers inside ICD 3 are powered by VDD targ
- \(V_{SS}\) line between ICD 3 and target not shown.

Note: 2 pins are ‘lost’:
- PGC is RB6
- PGD is RB7
How ICD 3 Works: Operation

- Program code into target
  - \( V_{PP} \) placed on \( VPP/#MCLR \)
  - User code programmed into Program Memory
  - Small Debug Executive is also programmed into high Program Memory
  - Working target clock is not required to program
- If code does not run on PIC, ICD 3 will not enter debug
  - check oscillator config

Note: VDD and VSS connections not shown
How ICD 3 Works: Operation (2)

- Use debugger IDE to set breakpoints and run
- Halt at a breakpoint and inspect/change registers
  - When instruction at breakpoint address has executed \( \Rightarrow \) load PC with the address of the Debug Executive
- Debug Executive transfers PIC18 internal state back to MPLAB IDE

Note: VDD and VSS connections not shown
Resources Used by ICD 3

In-circuit debugging uses the on-chip resources:

- #MCLR/VPP is shared for programming;
- Low-voltage ICSP programming is disabled (RB5 is available);
- RB6 and RB7 are reserved for ICSP/ICD;
- Two (hardware) stack levels are not available.
- Several general purpose file registers are reserved: 0x5EF-0x5FF (0x11, or 17 Bytes) plus some others
- Upper words of program memory area are reserved: up to 0x7D30-0x7FFF (0x2D0, or 720 Bytes)
- Shadow registers are not available. User’s application can use them, but cannot debug a FAST return because the ICD will overwrite the shadow registers when it gets a breakpoint.
The following memory resources are reserved when the IDC 3 is used with the PIC18F452

- **When Software Breakpoints are NOT used:**
  - Program memory: 0x7DC0-0x7FFF
  - Data Memory: 0x5F4-0x5FF; 0xF9C; 0xFD4; 0xFDB-0xFDF; 0xFE3-0xFE7; 0xFEB-0xFE7; 0xFFD-0xFFF

- **When Software Breakpoints ARE used:**
  - Program memory: 0x7D30-0x7FFF
  - Data Memory: 0x5EF-0x5FF; 0xF9C; 0xFD4; 0xFDB-0xFDF; 0xFE3-0xFE7; 0xFEB-0xFE7; 0xFFC; 0xFFD-0xFFF
P18Demo Project

Demonstration code on PICDEM 2 Plus board