

MASTERS 2015

The premier technical training conference for embedded control engineers



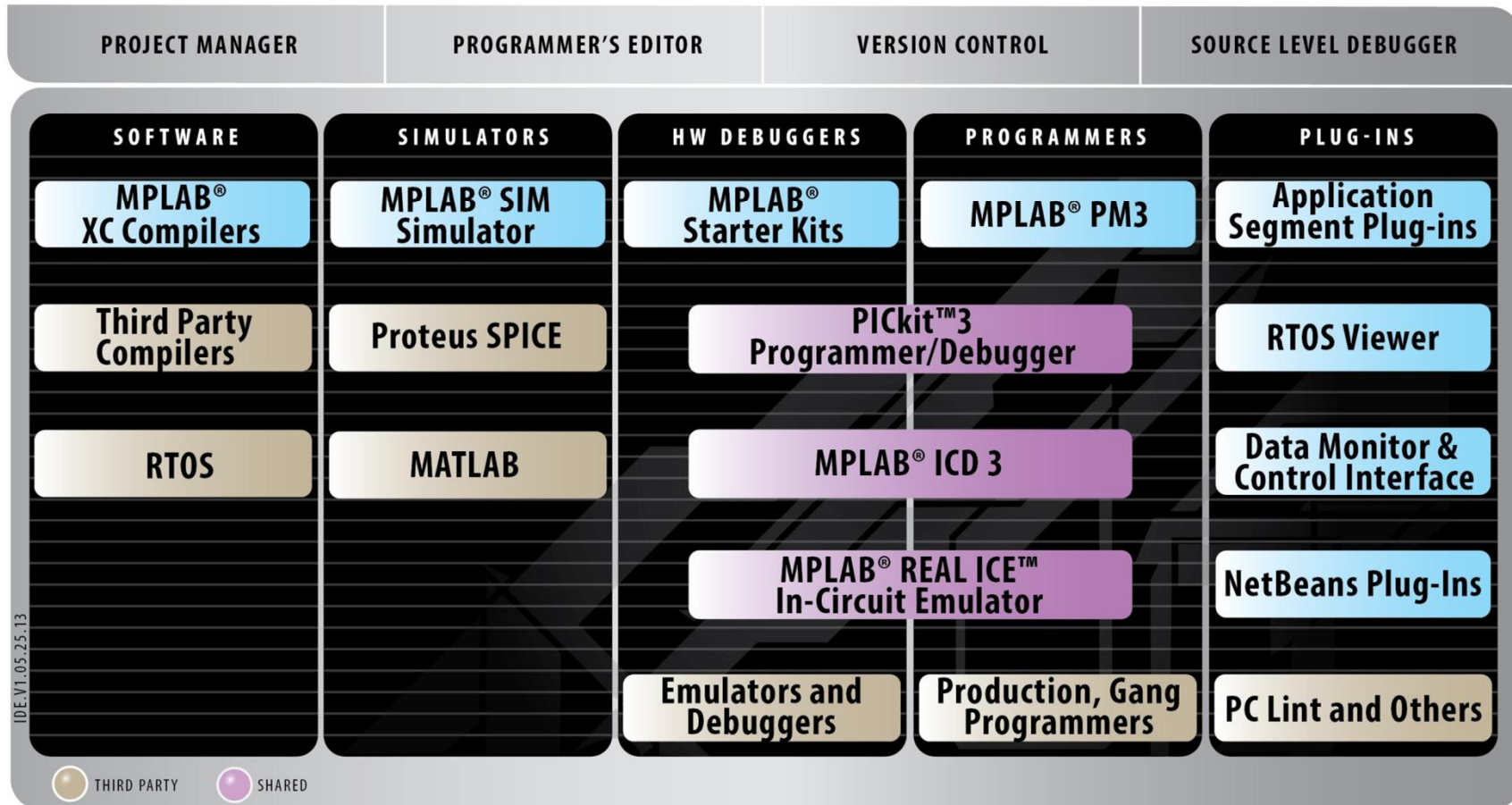
Отладочные средства Microchip

Development Tools Ecosystem

www.microchip.com/developmenttools



INTEGRATED DEVELOPMENT ENVIRONMENT



MPLAB[®] X IDE

www.microchip.com/mplabx



- Бесплатная среда
- Совместимость со всеми МК
- Работает под Windows, Linux и MAC OS
- Плагины для расширения возможностей
 - Создаются Microchip
 - Embedded Code Source:
www.embeddedcodesource.com



Награды:



MPLAB[®] XC C Compilers

www.microchip.com/mplabxc

Три варианта (Free, STD, PRO)

Три компилятора

- XC8 = 8-bit МК
- XC16 = 16-bit МК
- XC32 = 32-bit МК

Три типа лицензий

- Workstation, network server, site

Три платформы

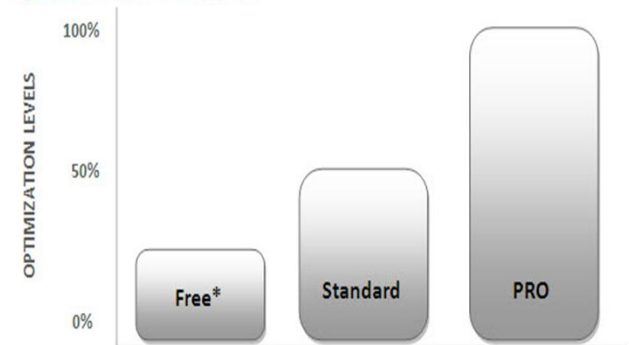
- Windows, Linux and MAC OS

Три награды:



Поддержка: SWLicensing@microchip.com

Optimization Levels



*Free Edition includes a 60-day PRO evaluation that can be started anytime.

Programmers/Debuggers

- | **Совместимы со всеми МК**
- | **Совместимы с MPLAB® X IDE и всеми компиляторами MPLAB XC**
- | **Работают в Windows, Linux and MAC OS**
- | **Три варианта**
 - | MPLAB REAL ICE™ внутрисхемный эмулятор
 - | MPLAB ICD 3
 - | PICkit™ 3
- | **MPLAB PM3 – Промышленный программатор**

Self-Directed Design Support

- | **Developer Help**

- | <http://microchip.wikidot.com/tools:start>

- | **Форум**

- | <http://www.microchip.com/forums/>



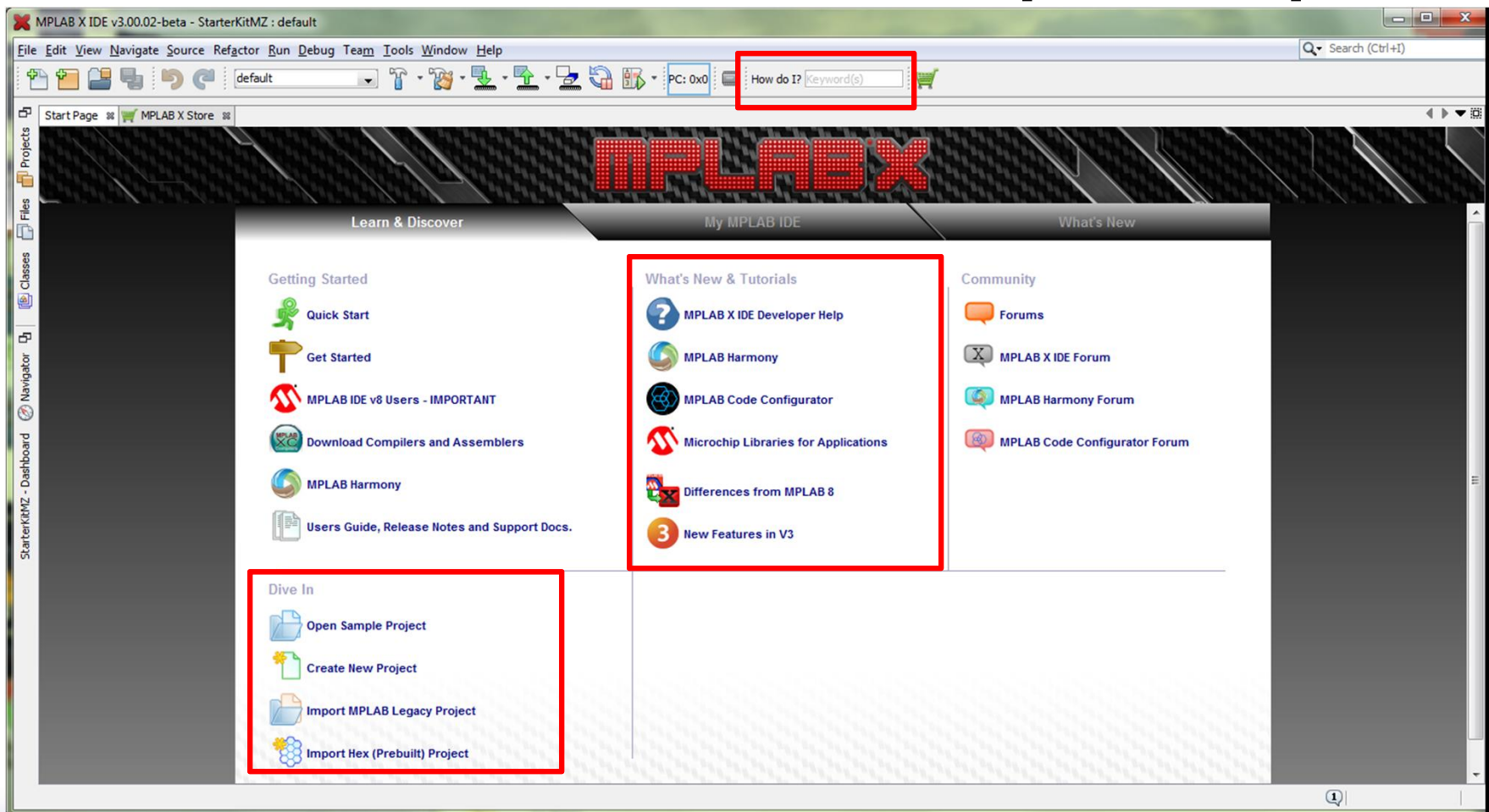
MICROCHIP

MASTERS 2015

Разработка в MPLAB[®] X IDE

Начало работы и помощь

- При старте открывается окно
- How do I? Поиск по developers help



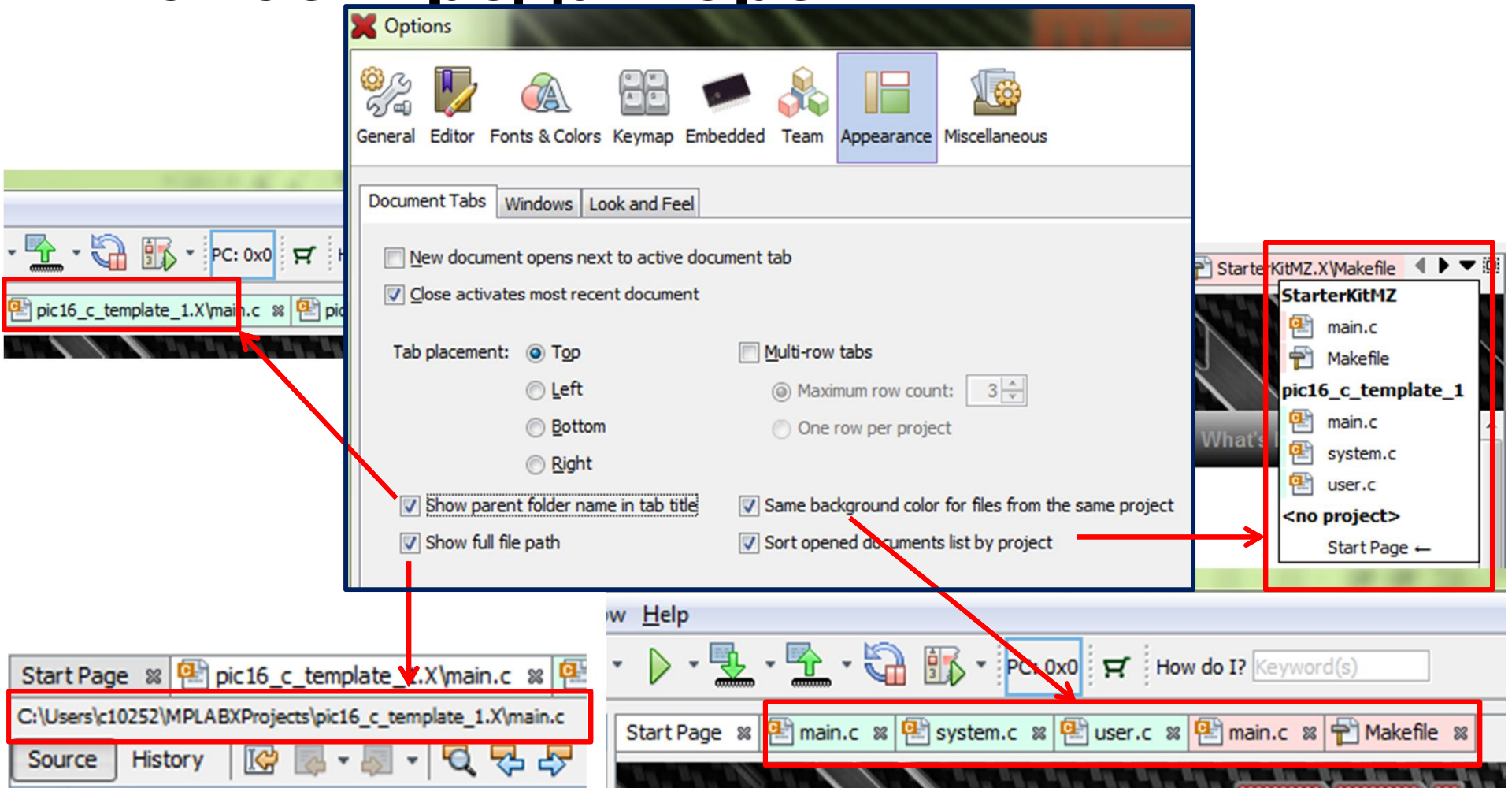
New!! MPLAB[®] X IDE v3.00

- Основан на свежей платформе **NetBeans 8.0.1**



- JRE 7
- Поддержка новейших систем контроля версий SVN и Git
- Исправлены ошибки
- Новые возможности

Новое в редакторе



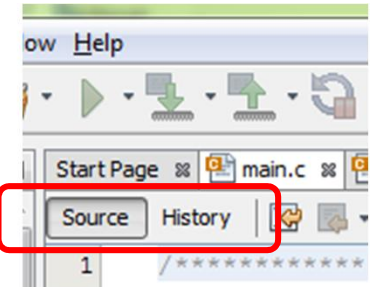
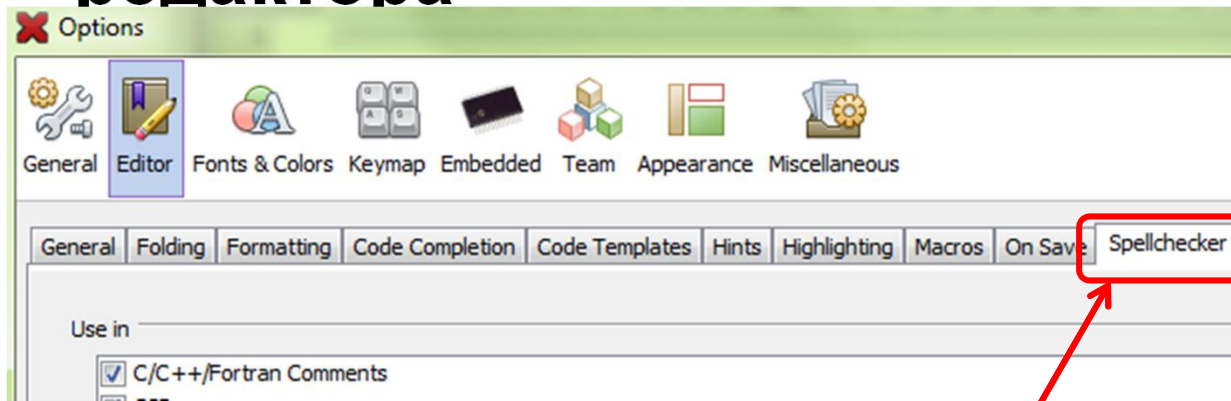
The screenshot illustrates the 'Options' dialog box in MPLAB X IDE v3.00, specifically the 'Appearance' tab. The dialog is divided into three sections: Document Tabs, Windows, and Look and Feel. The 'Document Tabs' section includes options for 'New document opens next to active document tab' (unchecked), 'Close activates most recent document' (checked), and 'Tab placement' (set to 'Top'). The 'Windows' section includes 'Multi-row tabs' (unchecked) and 'Maximum row count' (set to 3). The 'Look and Feel' section includes 'Show parent folder name in tab title' (checked), 'Show full file path' (checked), 'Same background color for files from the same project' (checked), and 'Sort opened documents list by project' (checked).

Red boxes and arrows highlight the following features:

- The 'Show full file path' checkbox in the 'Look and Feel' section, which is checked.
- The 'Sort opened documents list by project' checkbox in the 'Look and Feel' section, which is checked.
- The resulting file list in the IDE's document tabs, which is sorted by project. The list shows 'pic16_c_template_1.X\main.c' and 'pic16_c_template_1.X\main.c' (with the full path) in the top tabs, and 'main.c', 'system.c', and 'user.c' in the bottom tabs.

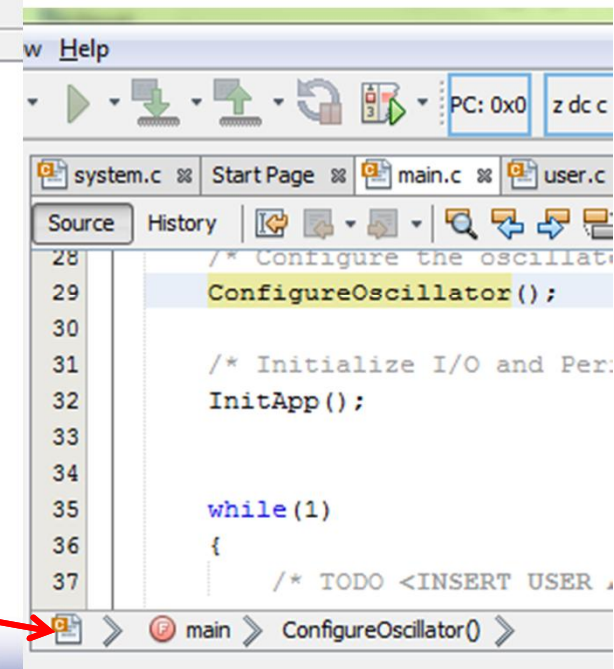
MPLAB® X IDE v3.00

Кнопки Source (исходник) и History (история изменений) в окне редактора



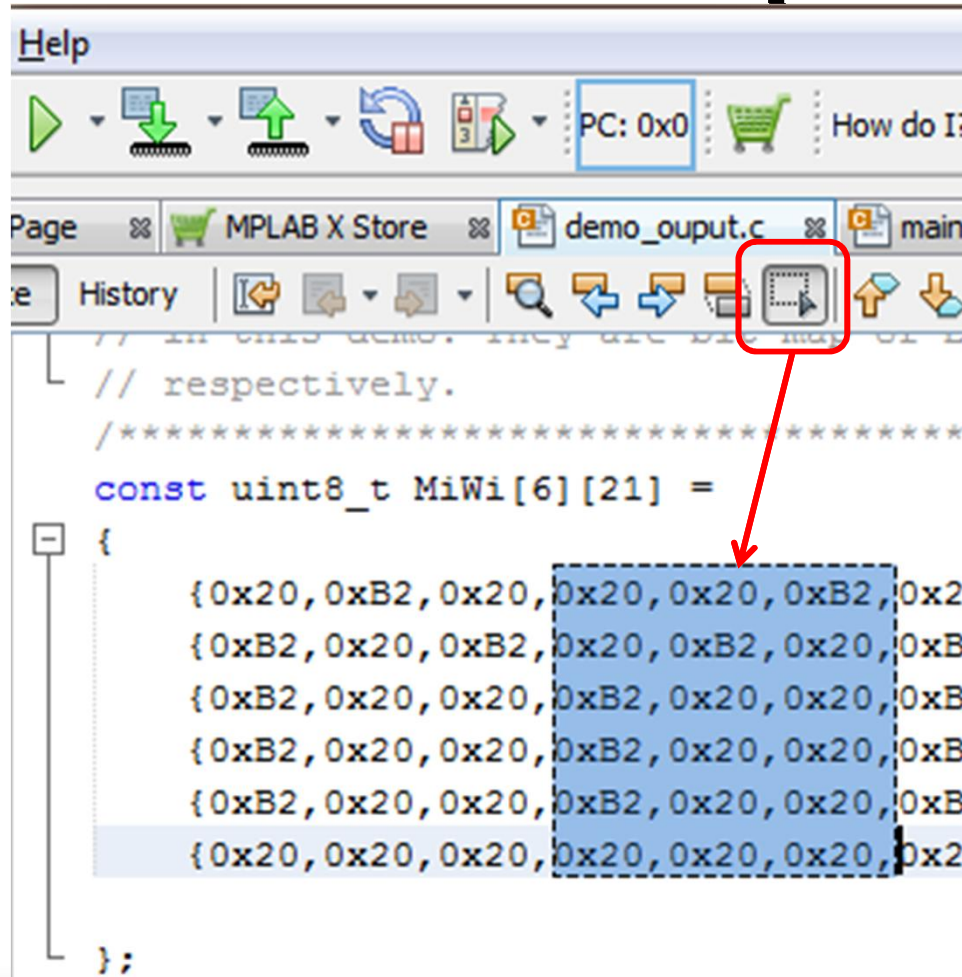
C/C++ comments spell checker

Путь функции



Режим выбора блока

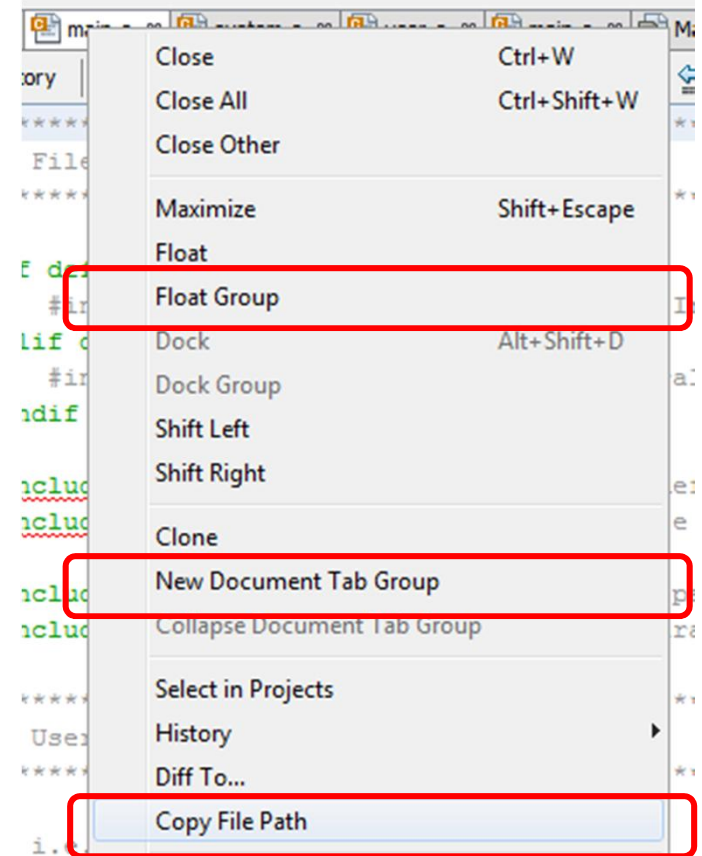
Block select



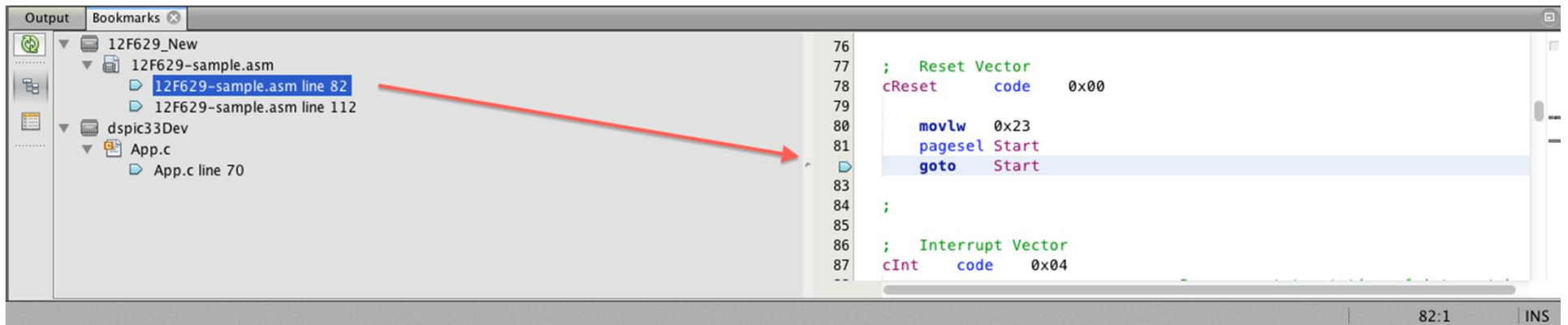
MPLAB® X IDE v3.00 *

Контекстное меню из file tab

- Плавающая группа редактируемых файлов
- Создание новой группы файлов
- Копирование полного пути файла

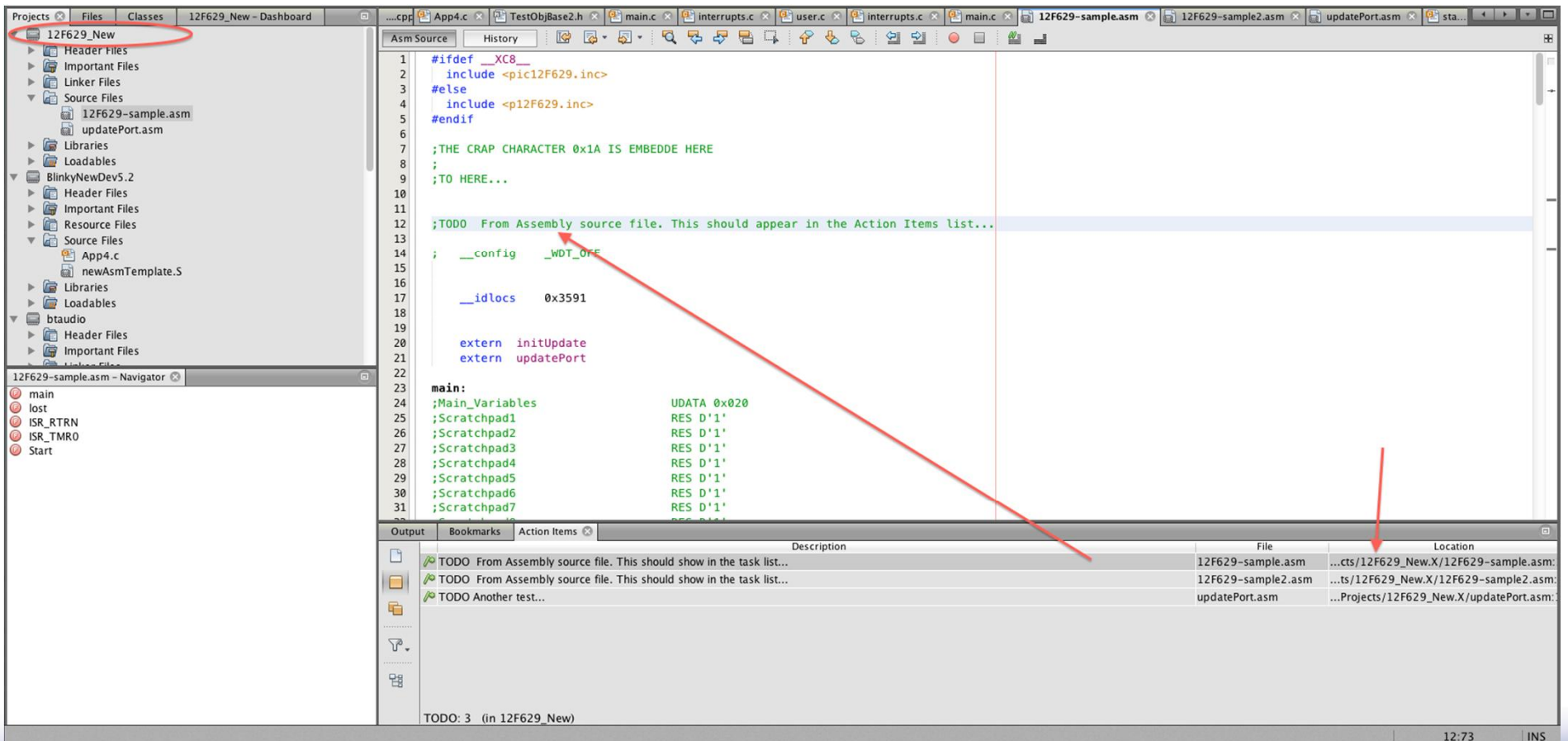


- Закладки. Древовидное представление. Ассоциация с проектами и файлами.



MPLAB® X IDE v3.00 *

«Задачи» переименованы в «Действия» перемещены в «Action Items»



The screenshot displays the MPLAB X IDE interface. On the left, the Project Explorer shows a project named '12F629_New' with a red circle around it. The main editor window shows an assembly source file with a green comment: `;TODO From Assembly source file. This should appear in the Action Items list...`. A red arrow points from this comment to the 'Action Items' tab in the Output window. The 'Action Items' window contains a table with the following data:

| Description | File | Location |
|--|--------------------|--|
| TODO From Assembly source file. This should show in the task list... | 12F629-sample.asm | ...cts/12F629_New.X/12F629-sample.asm: |
| TODO From Assembly source file. This should show in the task list... | 12F629-sample2.asm | ...ts/12F629_New.X/12F629-sample2.asm: |
| TODO Another test... | updatePort.asm | ...Projects/12F629_New.X/updatePort.asm: |

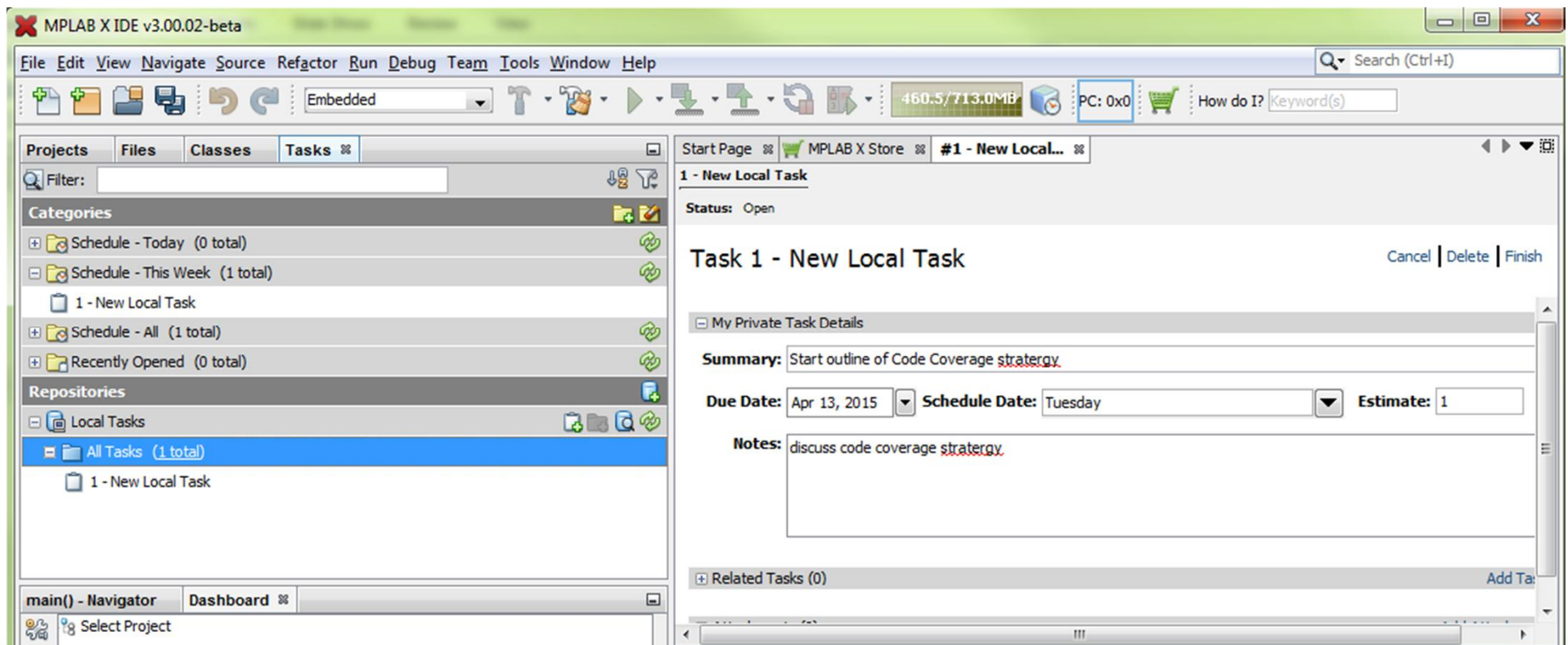
At the bottom of the IDE, the status bar shows 'TODO: 3 (in 12F629_New)' and the page number '17'.

MPLAB® X IDE v3.00

- | **Программистам на ассемблере**
 - | **Добавлены табуляция и форматирование**
 - | **Добавлены гиперссылки и навигация на заголовочные файлы**
 - | **Добавлены «Действия» (Action Items) для .asm файлов**
 - | **//TODO и подобные комментарии фильтруются и отображаются в Action Items**

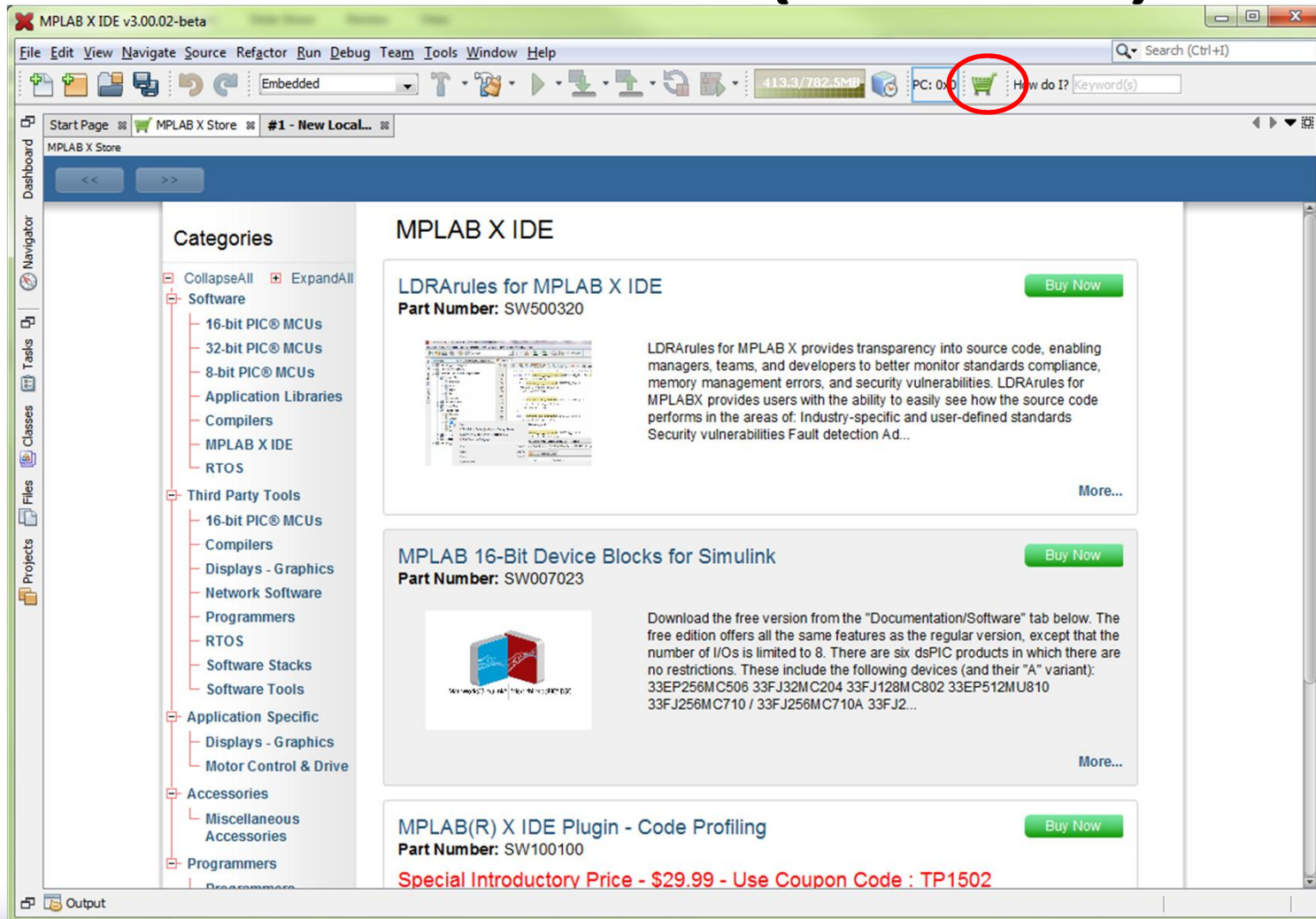
MPLAB® X IDE v3.00 *

- | Задачи (Tasks) стали отображаться в календаре
- | Могут быть привязаны к Задачам репозиториях типа JIRA



MPLAB[®] X IDE v3.00

MPLAB X IDE Store (Магазин)



MPLAB X IDE v3.00.02-beta

File Edit View Navigate Source Refactor Run Debug Team Tools Window Help

413.3/782.5MB PC: D:\ How do I? Keyword(s)

Start Page MPLAB X Store #1 - New Local...

MPLAB X Store

Categories

- CollapseAll ExpandAll
- Software
 - 16-bit PIC[®] MCUs
 - 32-bit PIC[®] MCUs
 - 8-bit PIC[®] MCUs
 - Application Libraries
 - Compilers
 - MPLAB X IDE
 - RTOS
- Third Party Tools
 - 16-bit PIC[®] MCUs
 - Compilers
 - Displays - Graphics
 - Network Software
 - Programmers
 - RTOS
 - Software Stacks
 - Software Tools
- Application Specific
 - Displays - Graphics
 - Motor Control & Drive
- Accessories
 - Miscellaneous Accessories
- Programmers

MPLAB X IDE

LDRules for MPLAB X IDE Buy Now
Part Number: SW500320

LDRules for MPLAB X provides transparency into source code, enabling managers, teams, and developers to better monitor standards compliance, memory management errors, and security vulnerabilities. LDRules for MPLABX provides users with the ability to easily see how the source code performs in the areas of: Industry-specific and user-defined standards Security vulnerabilities Fault detection Ad...

More...

MPLAB 16-Bit Device Blocks for Simulink Buy Now
Part Number: SW007023

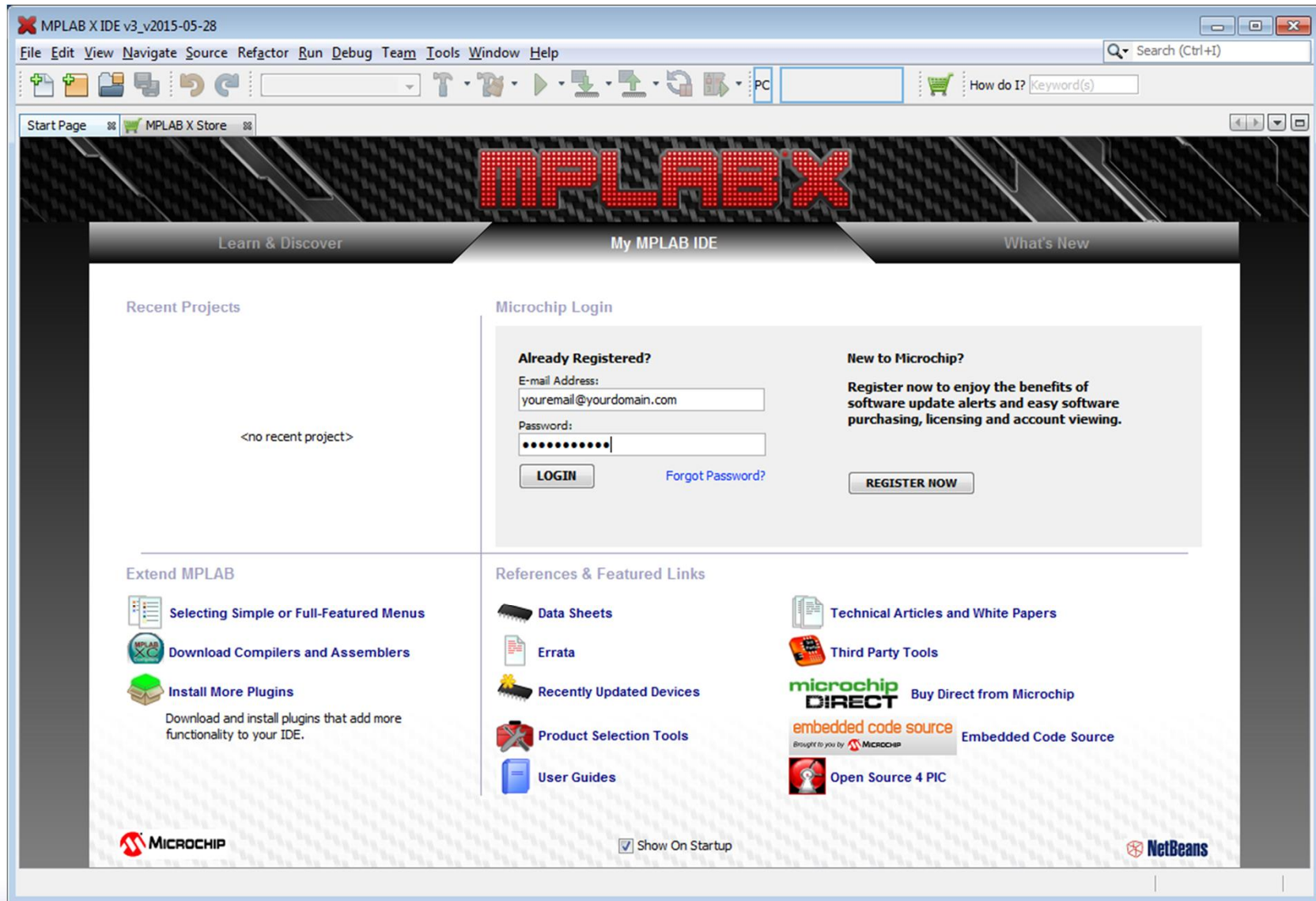
Download the free version from the "Documentation/Software" tab below. The free edition offers all the same features as the regular version, except that the number of I/Os is limited to 8. There are six dsPIC products in which there are no restrictions. These include the following devices (and their "A" variant): 33EP256M C506 33FJ32MC204 33FJ128M C802 33EP512MU810 33FJ256M C710 / 33FJ256M C710A 33FJ2...

More...

MPLAB(R) X IDE Plugin - Code Profiling Buy Now
Part Number: SW100100

Special Introductory Price - \$29.99 - Use Coupon Code : TP1502

Login for mySoftware Account *



The screenshot shows the MPLAB X IDE v3 interface. The title bar reads "MPLAB X IDE v3_v2015-05-28". The menu bar includes File, Edit, View, Navigate, Source, Refactor, Run, Debug, Team, Tools, Window, and Help. A search bar is located in the top right corner. The main content area features a large "MPLAB X" logo at the top. Below the logo, there are three tabs: "Learn & Discover", "My MPLAB IDE", and "What's New". The "My MPLAB IDE" tab is active, displaying a "Microchip Login" section. This section is divided into two columns: "Already Registered?" and "New to Microchip?". The "Already Registered?" column contains fields for "E-mail Address:" (with the placeholder "youremail@yourdomain.com") and "Password:" (with masked characters "••••••••"). Below these fields are "LOGIN" and "Forgot Password?" buttons. The "New to Microchip?" column contains a "REGISTER NOW" button and a text block: "Register now to enjoy the benefits of software update alerts and easy software purchasing, licensing and account viewing." Below the login section, there are two main areas: "Extend MPLAB" and "References & Featured Links". "Extend MPLAB" includes links for "Selecting Simple or Full-Featured Menus", "Download Compilers and Assemblers", and "Install More Plugins" (with a sub-note: "Download and install plugins that add more functionality to your IDE."). "References & Featured Links" includes links for "Data Sheets", "Errata", "Recently Updated Devices", "Product Selection Tools", "User Guides", "Technical Articles and White Papers", "Third Party Tools", "microchip DIRECT Buy Direct from Microchip", "embedded code source Embedded Code Source (Brought to you by Microchip)", and "Open Source 4 PIC". At the bottom left is the Microchip logo, and at the bottom right is the NetBeans logo. A "Show On Startup" checkbox is visible near the bottom center.

Navigation after Login *



The screenshot shows the MPLAB X IDE interface. At the top, the "MPLAB X" logo is displayed in red, pixelated font against a dark, textured background. Below the logo is a navigation bar with three tabs: "Learn & Discover", "My MPLAB IDE", and "What's New". The "My MPLAB IDE" tab is selected. The main content area is divided into two sections. On the left, under "Recent Projects", there is a single project listed: "dsPIC33EP256MU814" with a small icon of a microcontroller. On the right, under "Microchip Login (ustestacc@yahoo.com)", there is a list of user actions: "You have 6 new alerts" (with an orange warning icon), "Shop MPLAB X Store" (with a green shopping cart icon), "View mySoftware Account" (with a green computer monitor icon), and "Logout" (with a blue exit door icon). A mouse cursor is positioned over the "Logout" option.

Alerts for mySoftware Account *



Recent Projects

 dsPIC33EP256MU814

Microchip Login (ustestacc@yahoo.com)



You have 6 new alerts. Click below for more information:

- MPLAB XC32++ PRO Compiler (Workstation License) has expired on 13-May-2017.
- MPLAB XC32 PRO Compiler (Workstation License) has expired on 09-Apr-2017.
- MPLAB XC8 PRO Compiler (Workstation License) has expired on 15-Feb-2019.
- MPLAB XC8 PRO Compiler (Workstation License) has expired on 05-Mar-2016.
- MPLAB XC32++ PRO Compiler (Workstation License) has expired on 13-May-2017.
- MPLAB XC32++ PRO Compiler (Workstation License) has expired on 08-Apr-2020.

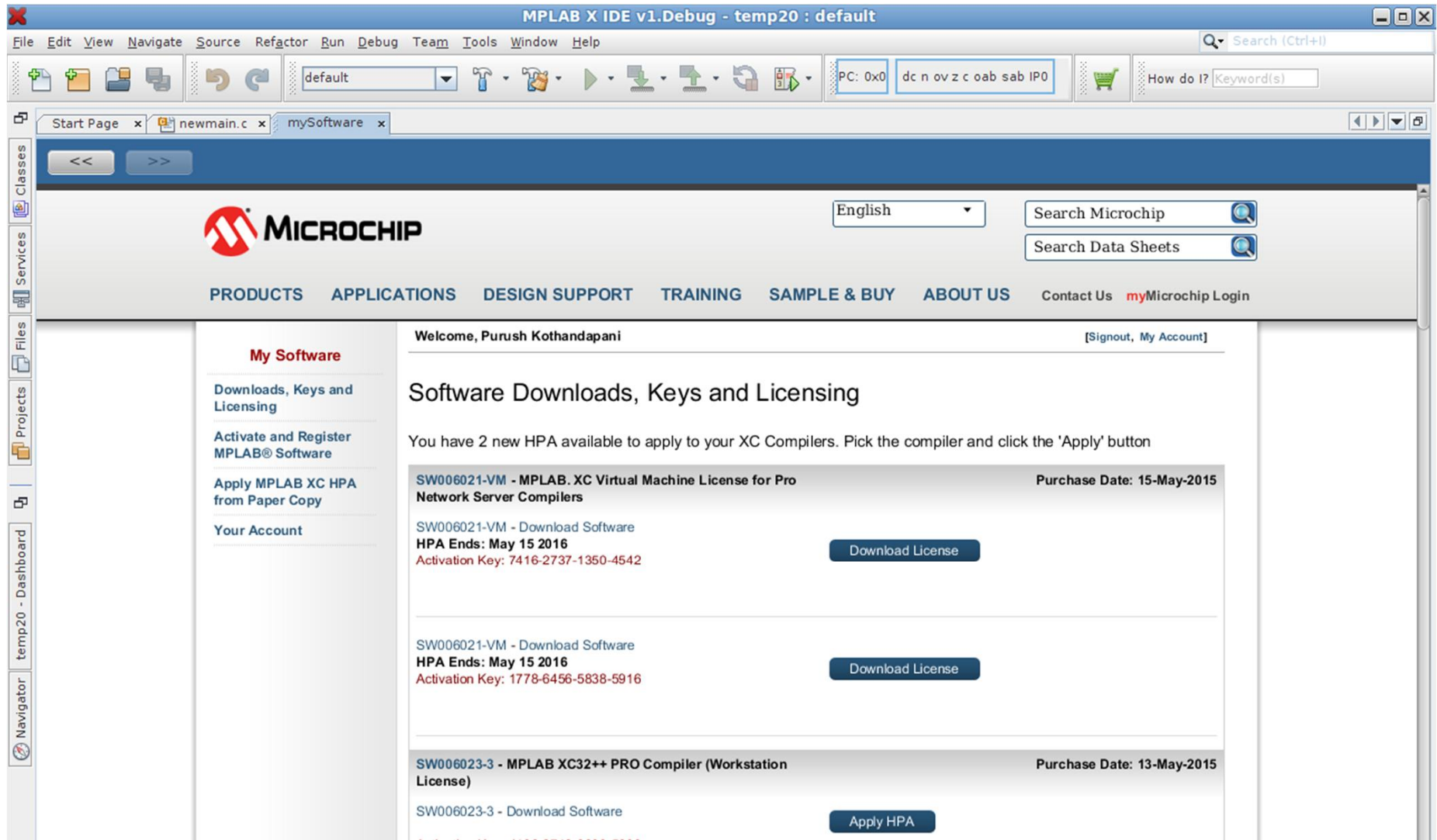


[Back](#)

[Clear Alerts](#)

[Refresh](#)

MPLAB[®] X IDE mySoftware Account



The screenshot shows the MPLAB X IDE interface with the mySoftware account page open. The IDE title bar reads "MPLAB X IDE v1.Debug - temp20 : default". The menu bar includes File, Edit, View, Navigate, Source, Refactor, Run, Debug, Team, Tools, Window, and Help. The toolbar contains various icons for file operations and development. The browser tabs show "Start Page", "newmain.c", and "mySoftware".

The mySoftware page features the Microchip logo, a language dropdown set to "English", and search boxes for "Search Microchip" and "Search Data Sheets". The navigation menu includes PRODUCTS, APPLICATIONS, DESIGN SUPPORT, TRAINING, SAMPLE & BUY, and ABOUT US, along with links for "Contact Us" and "myMicrochip Login".

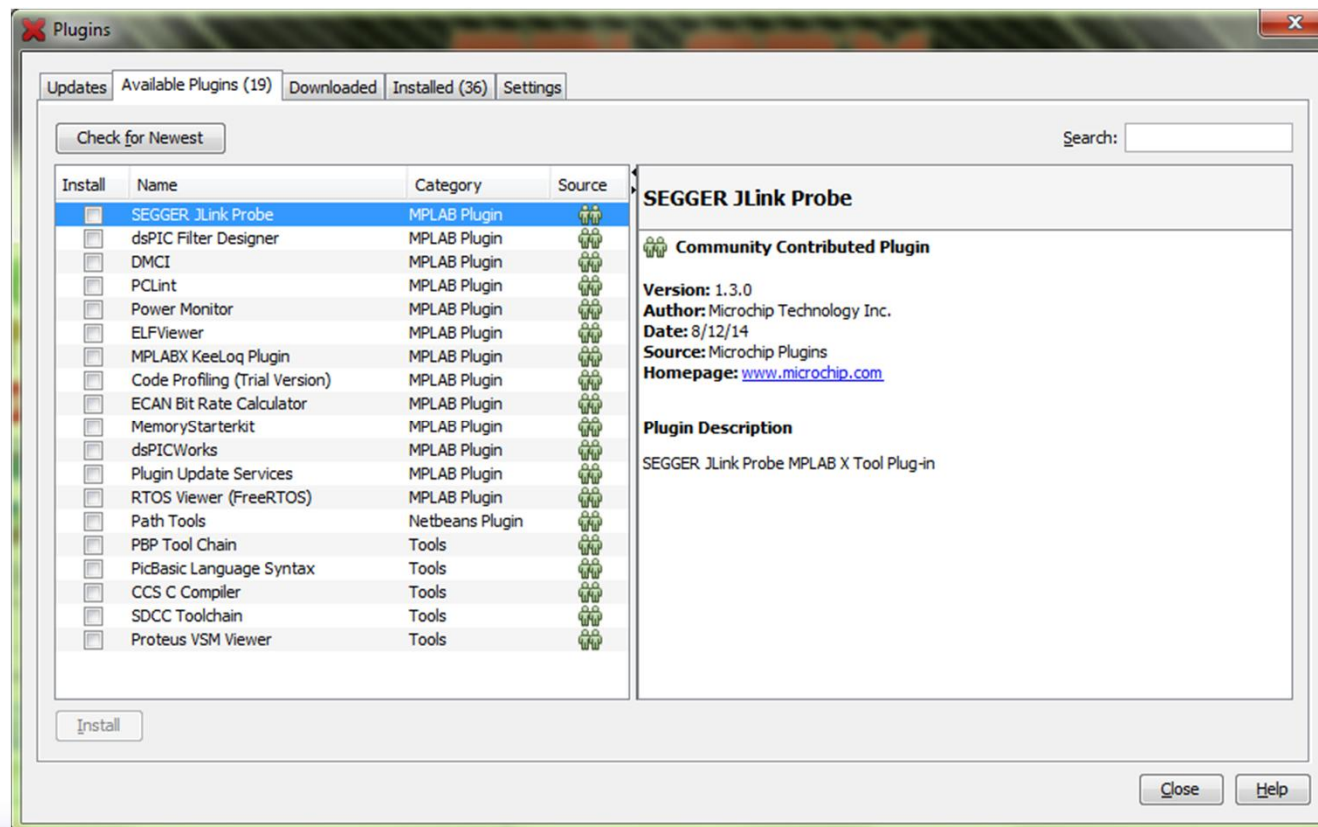
The main content area is titled "My Software" and includes sections for "Downloads, Keys and Licensing", "Activate and Register MPLAB[®] Software", "Apply MPLAB XC HPA from Paper Copy", and "Your Account". A welcome message for "Purush Kothandapani" is displayed, along with a "[Signout, My Account]" link.

The "Software Downloads, Keys and Licensing" section contains the following information:

- SW006021-VM - MPLAB. XC Virtual Machine License for Pro Network Server Compilers** (Purchase Date: 15-May-2015)
 - SW006021-VM - Download Software
 - HPA Ends: May 15 2016
 - Activation Key: 7416-2737-1350-4542
 - Download License
- SW006021-VM - Download Software**
 - HPA Ends: May 15 2016
 - Activation Key: 1778-6456-5838-5916
 - Download License
- SW006023-3 - MPLAB XC32++ PRO Compiler (Workstation License)** (Purchase Date: 13-May-2015)
 - SW006023-3 - Download Software
 - Apply HPA

Расширения IDE

- | **Plugins** используются для расширения функциональности среды разработки
- | Установка из MPLAB X IDE или через загруженный файл **.NBM**
- | Доступны в Embedded Code Source (ECS) или от сторонних разработчиков



Расширения *

- | **Доступные плагины:**
 - | МНС - MPLAB® Harmony Configurator
 - | **МСС - MPLAB Code Configurator***
 - | **DMCI - Data Monitor & Control Interface***
 - | ***(будем изучать на лабораторных занятиях)**
 - | MPLAB Pro Code Profiler (Free Trial)
 - | Design Aid for MCP19110/1 MCP19118/9
 - | FREE RTOS viewer
 - | SEGGER J-Link probe
 - | LDRA rules (Анализ кода)
 - | Сторонние расширения от PBP, CCS и др..
- | **Разработаны**
 - | NetBeans community
 - | Инженерами по применениям
 - | Сторонними разработчиками



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Новости MPLAB® XC Компиляторов

Оптимизация



- PRO – наилучшая оптимизация по скорости и размеру
- STD – оптимизация по скорости и размеру
- FREE

High Priority Access (HPA)

- Обновление компиляторов

Производительность/ Размер

CoreMark

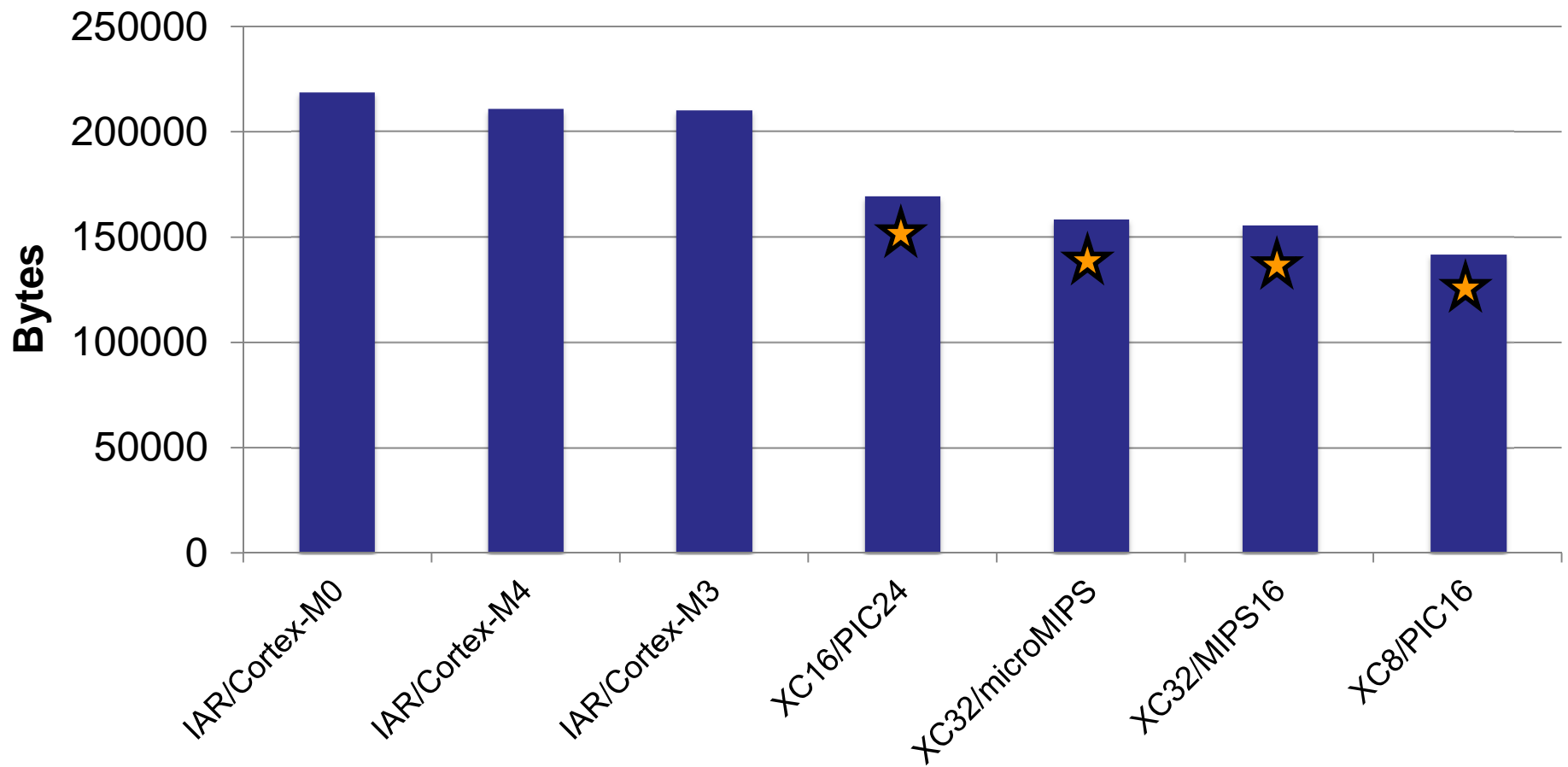
- XC8 – 0.11 CM/MHz 7.23 CM
- XC16 – 1.89 CM/MHz 132.39 CM
- XC32 – 3.27 CM/MHz 654.36 CM
- Сертифицированы и опубликованы
EEMBC.org

Сравнение размера использует EEMBC AutoBench

- Репрезентативный, стандартный код

Сравнение размера кода

EEMBC AutoBench Total using 16-bit data

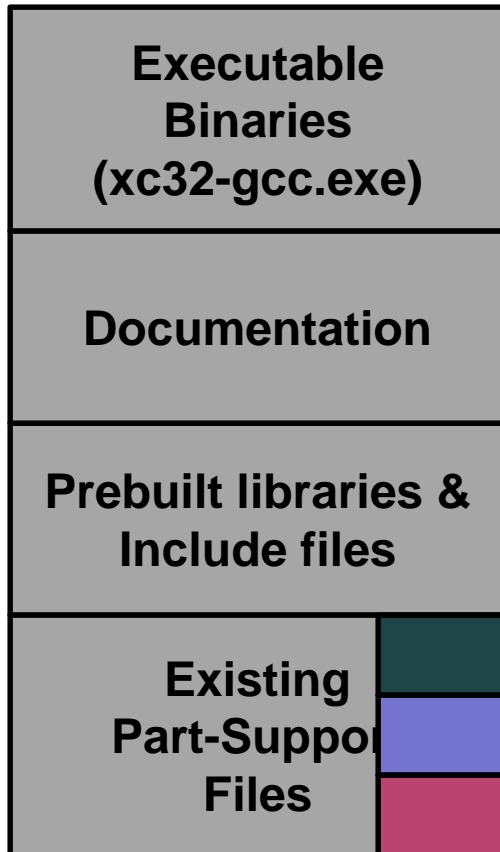


Ключевые улучшения

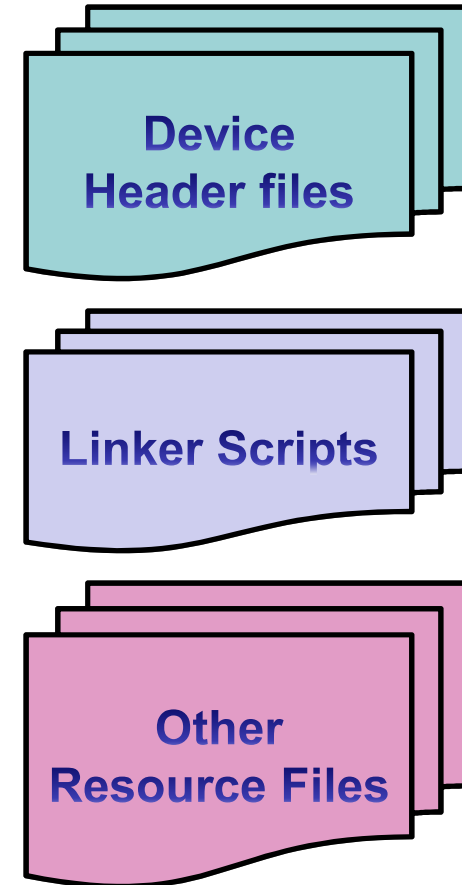
- | **XC8 Гибридная модель стека (Hybrid Stack model)**
 - | Использует программный и компилированный (compiled) стек.
- | **XC16 Улучшен планировщик команд**
 - | Увеличение производительности и размера кода
- | **XC32 Поддержка модуля Floating-Point**
 - | Использует аппаратную поддержку FPU в новых PIC32MZ EF
- | **Relaxed math libs**
 - | Меньше и быстрее, но менее детальный отчет об ошибках
- | **DSP & Fixed-Point Arithmetic support**
 - | `_Fract` & `_Accum` типы данных в C коде

Бесплатные патчи поддержки МК

Full Install



Part-Support Patch





- | **Доступ к любой версии компилятора**
 - | Не нужна НРА
- | **Нет платы за лицензию**
 - | Помесячная оплата

- | **Скоро...**



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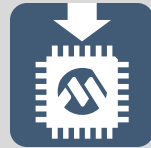
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Внутрисхемная Отладка и Эмуляция

Microcontroller Design Environment



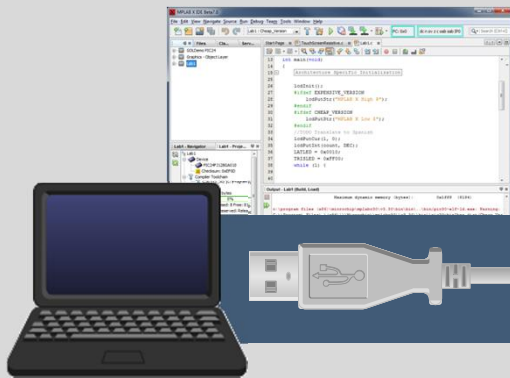
Integrated Development Environment



Programmer Debugger



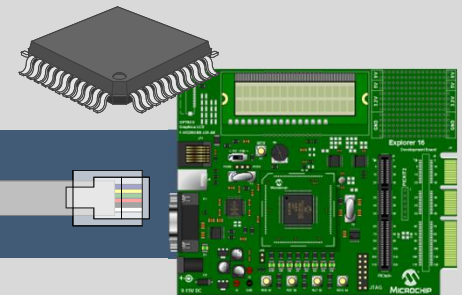
Target Hardware



MPLAB® X IDE
C Compiler
C++ Compiler
Assembler



MPLAB REAL ICE™
in-circuit emulator
MPLAB ICD 3
PICkit™ 2
PICkit™ 3



Explorer 16
PICDEM™ 2 Plus
Your Hardware...

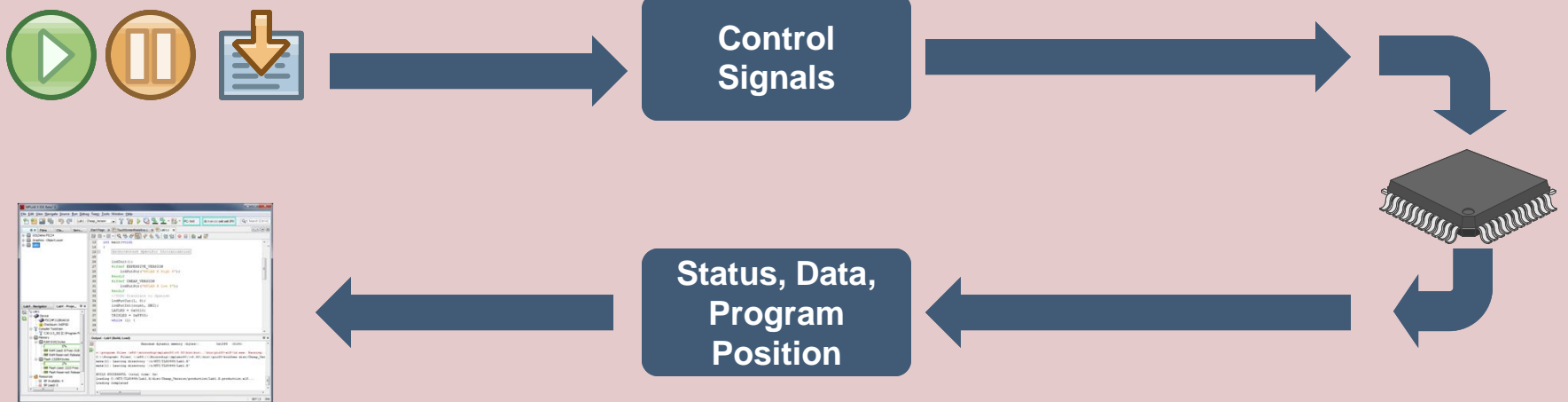
Что такое Отладчик?



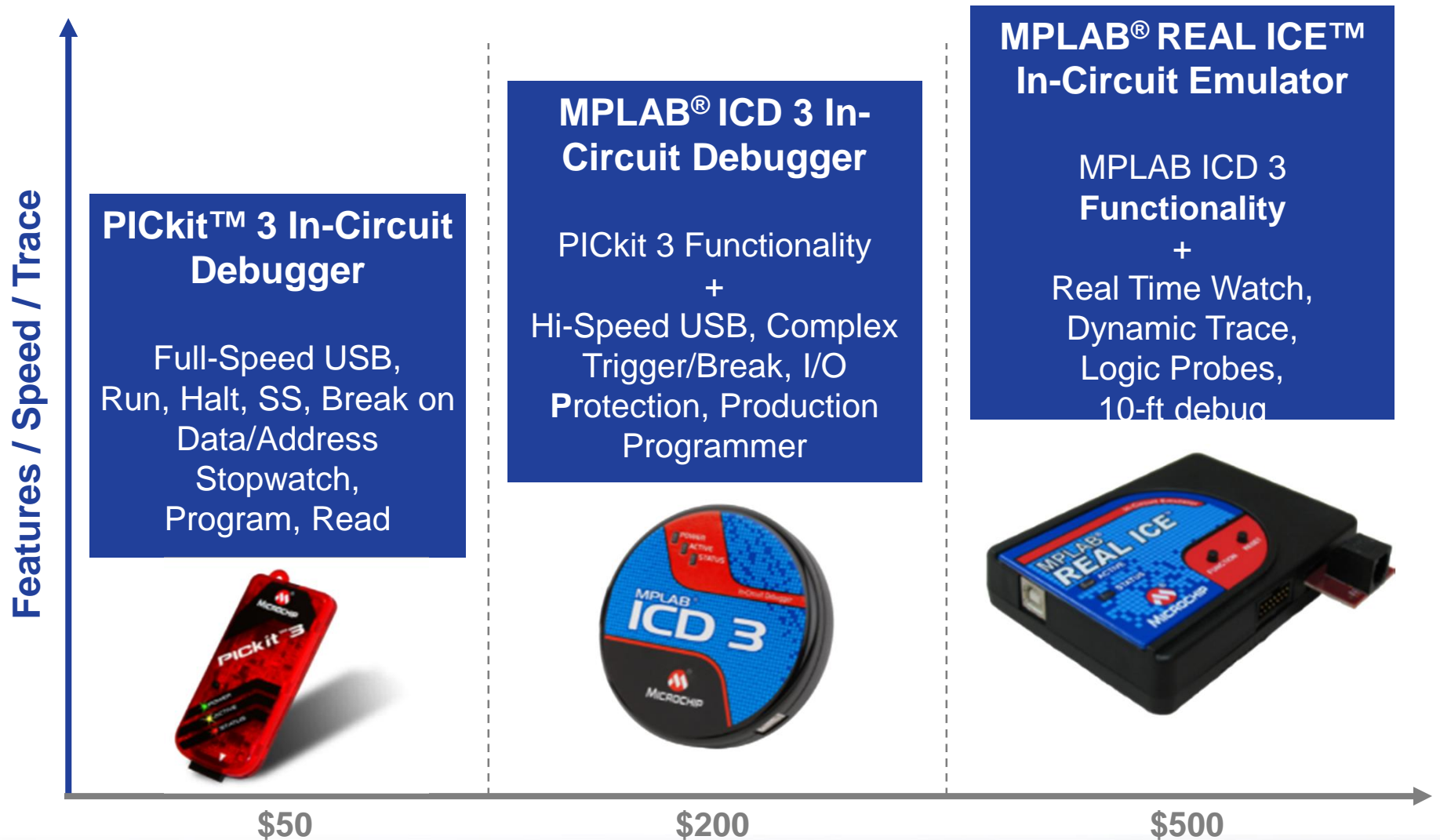
Programming Function



Debugging Function






Hardware






The MPLAB® X IDE Ecosystem

In-Circuit Debug Tool Feature Comparison

| Feature |  PICKIT™ 3 Debugger |  MPLAB® ICD 3 |  MPLAB REAL ICE™ in-circuit emulator |
|---------------------------------------|--|--|---|
| USB Speed | Full | Full / High | Full / High |
| Power to Target | ü | ü | |
| HW Breakpoints | ü | ü | ü |
| SW Breakpoints & Stopwatch | | ü | ü |
| Trace | | | ü |
| Data Capture | | | ü |
| Logic Probe / Trigger | | | ü |

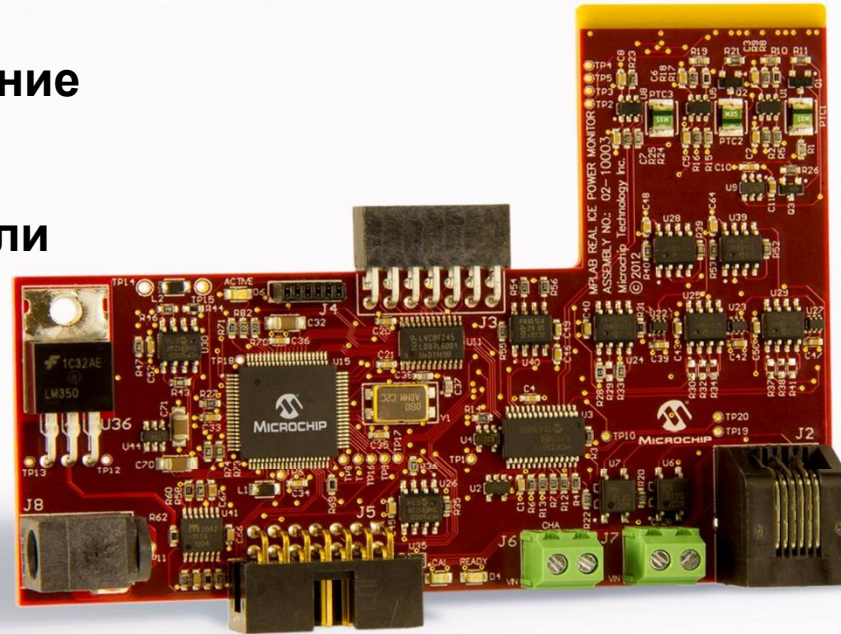
Возможности отладчиков

| Feature | PIC10F PIC12F PIC16F | PIC16F1x | PIC18F | dsPIC30F | PIC24F | PIC24H dsPIC33F | PIC32MX | Tool |
|------------------------------|----------------------------|----------|--------|----------|--------|--------------------|---------|---|
| Trace Data & Program Flow | - | - | ü | ü | ü | ü | ü |  |
| Runtime Watch | - | ü | ü* | - | ü | ü | ü | |
| Software Breakpoints | - | ü | ü | ü | ü | ü | ü |  |
| Break Address or Data Match | - | ü | ü | ü | ü | ü | ü | |
| Break on Data Fetch or Write | - | ü* | ü* | ü | ü | ü | ü | |
| Pass Counter | - | ü* | ü | ü | ü | ü | ü | |
| Stopwatch | - | ü* | ü* | ü | ü | ü | ü | |
| WDT Overflow | - | ü* | ü | ü | ü | ü | ü | |
| Run, Halt | ü | ü | ü | ü | ü | ü | ü |  |
| Single Step | ü | ü | ü | ü | ü | ü | ü | |
| Hardware Breakpoints | 1 | 1-3 | 1-3 | 1-4 | 1-6 | 1-6 | 1-6 | |
| Peripheral Freeze on Halt | ü* | ü | ü | ü | ü | ü | ü | |

* Does not apply to all members of family

MPLAB[®] REAL ICE[™] Power Monitor

- | Измерение тока от 1мкА до 1А
- | Может предоставлять питание для отлаживаемого устройства (до 1А)
- | Измерение тока системы или микроконтроллера
- | Временные отметки
- | Power Breakpoints
- | Графики в MPLAB X IDE
 - | Напряжение
 - | Ток
 - | Измерение времени
- | Профилирование потребления – как код влияет на потребление устройства

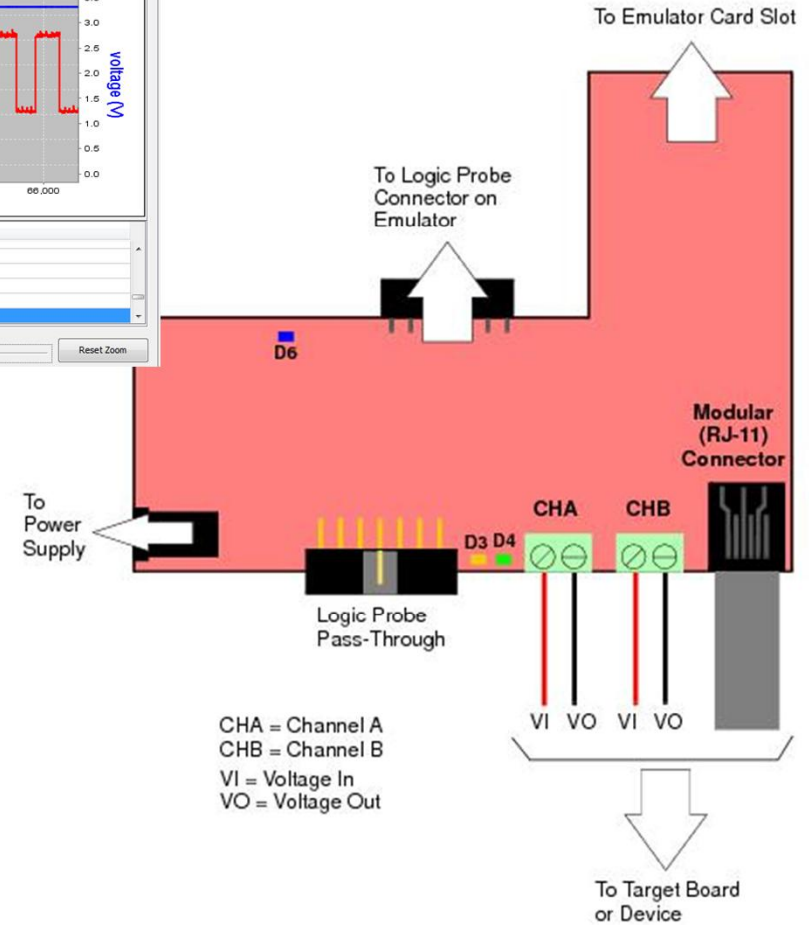
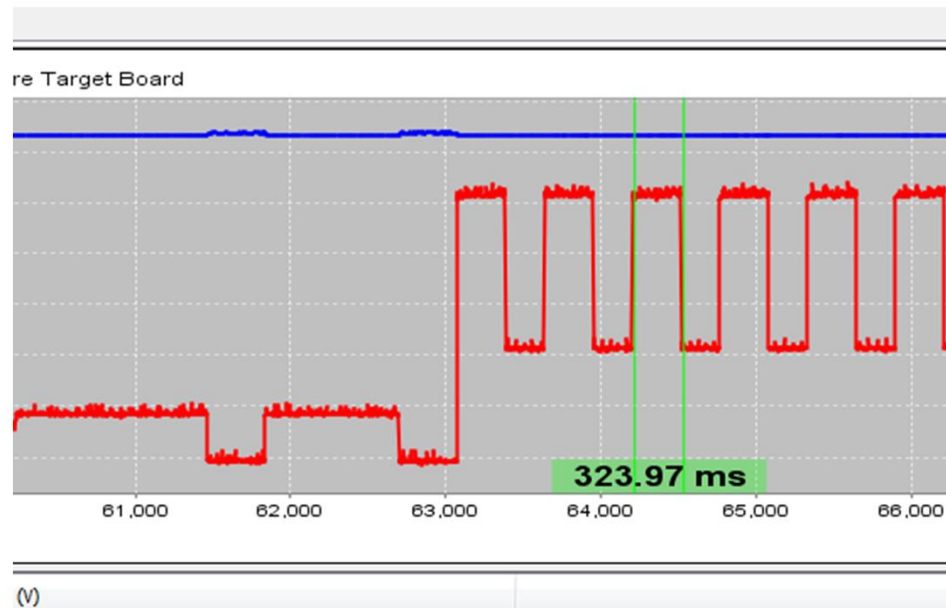
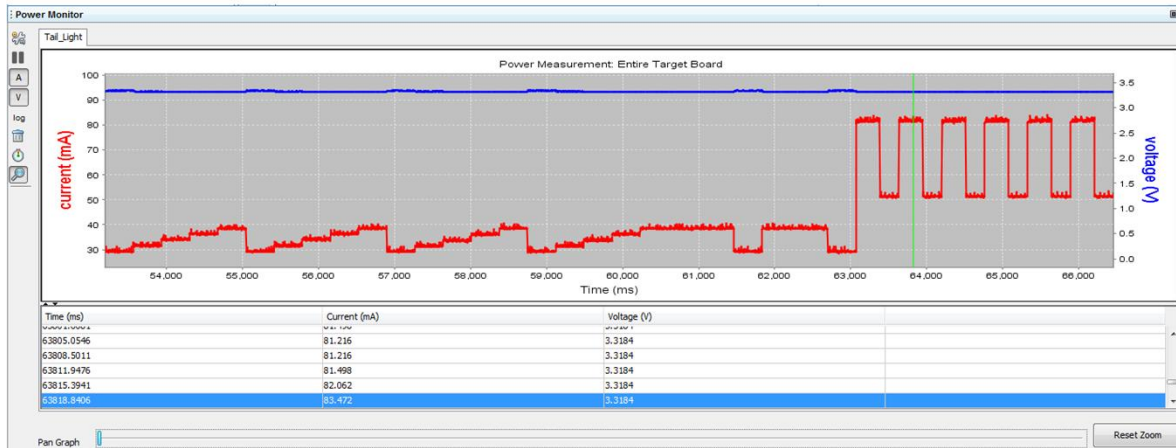


MPLAB[®] REAL ICE[™] Power Monitor
(AC244008)

MPLAB[®] REAL ICE[™] Power Monitor



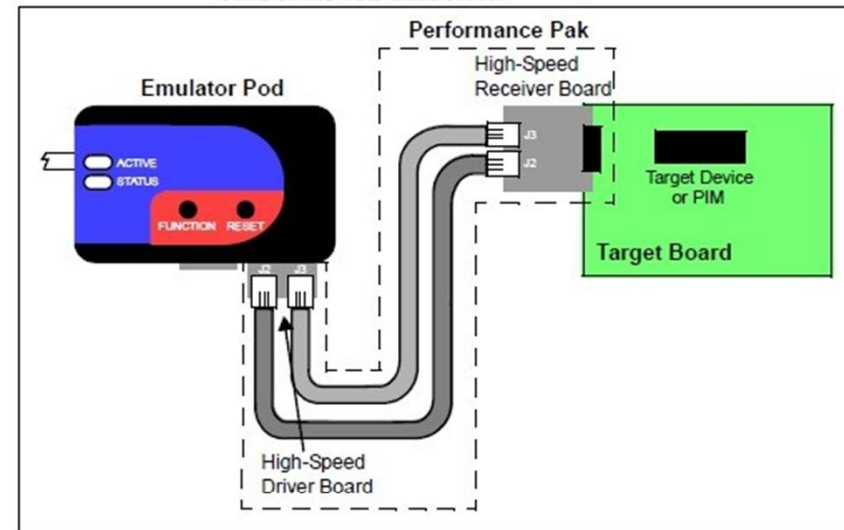
MPLAB[®]
CERTIFIED



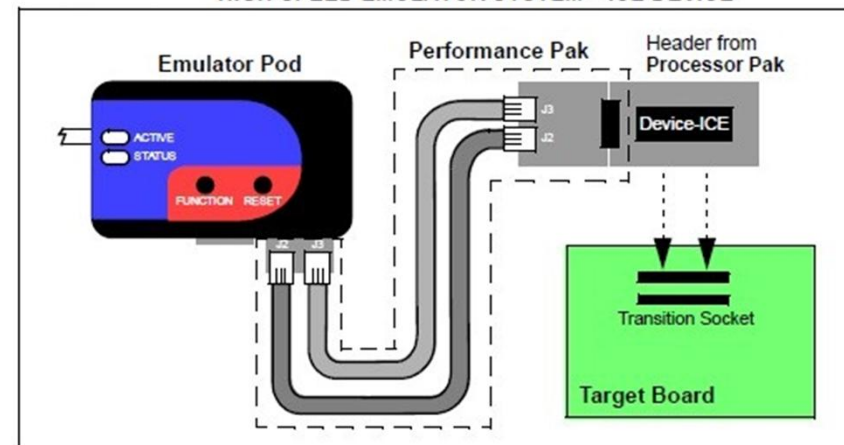
MPLAB® REAL ICE™ Performance Pak

- Для использования в шумном окружении
- Высокоскоростной драйвер
- Трассировка быстрых сигналов
- Больше длина кабеля CAT5 (до 3м)
- Используется LVDS
- Позволяет скоростную трассировку по последовательному каналу

HIGH-SPEED EMULATOR SYSTEM – DEVICE WITH ON-BOARD ICE CIRCUITRY



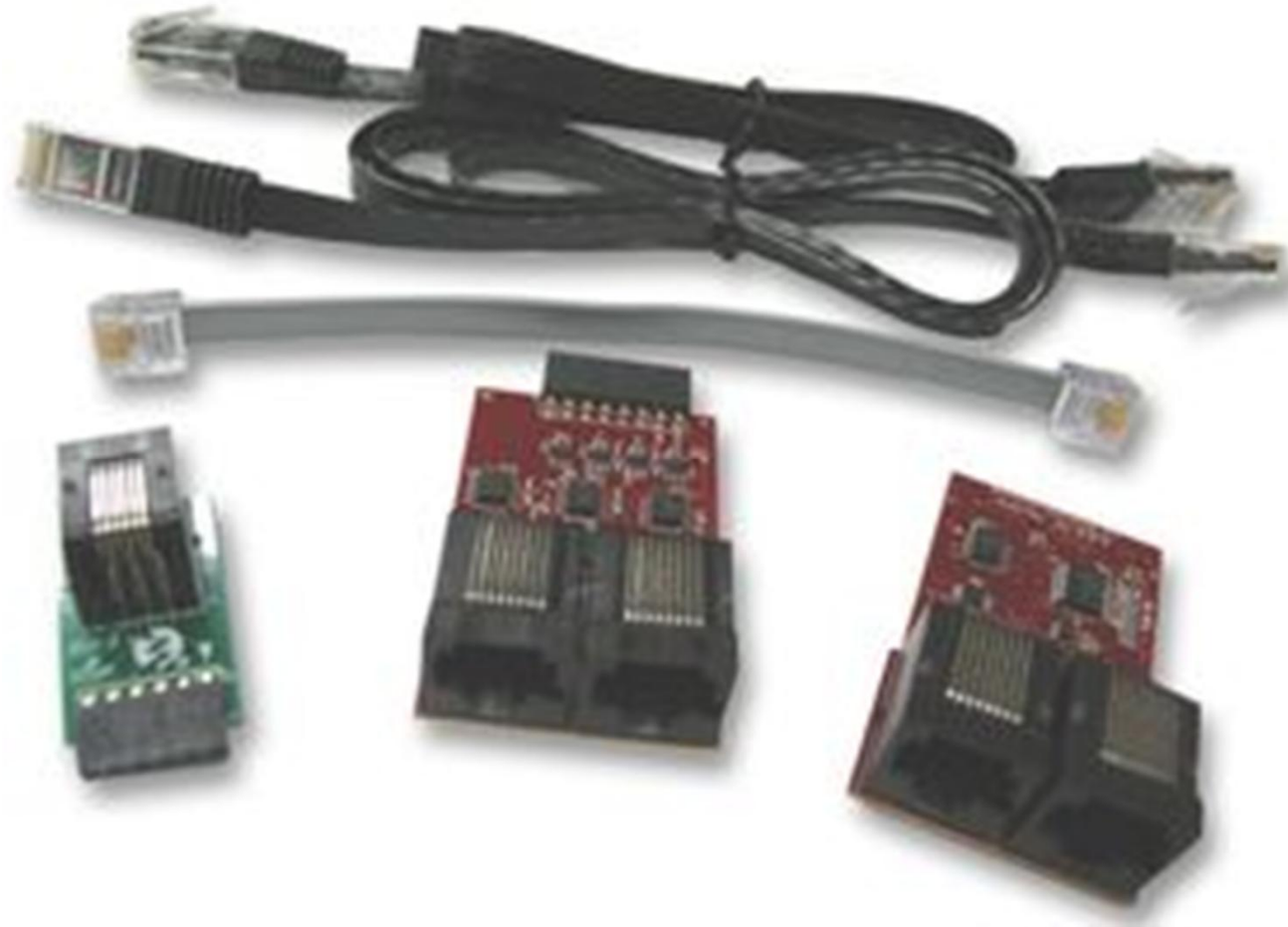
HIGH-SPEED EMULATOR SYSTEM – ICE DEVICE





MICROCHIP
MASTERS 2015

MPLAB[®] REAL ICE[™] Performance Pak *



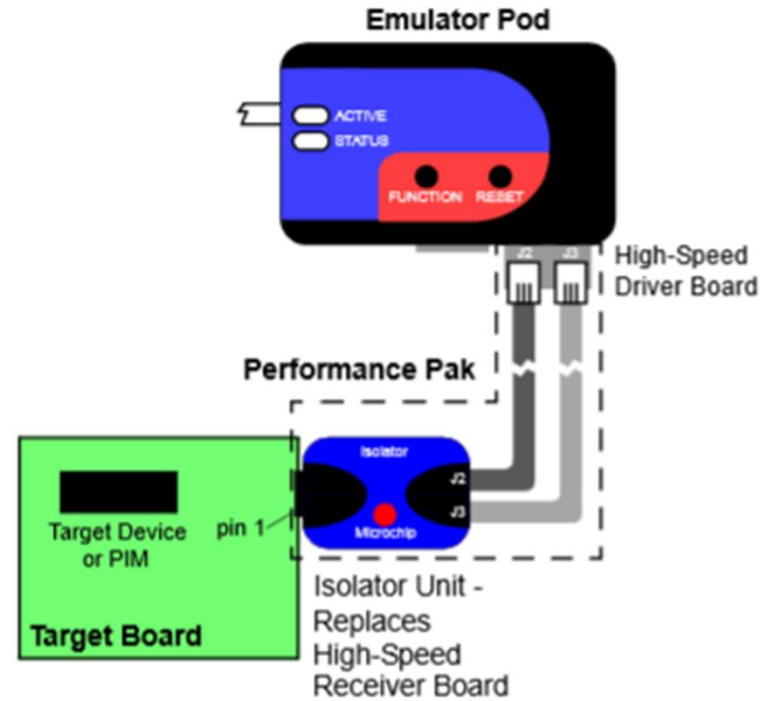
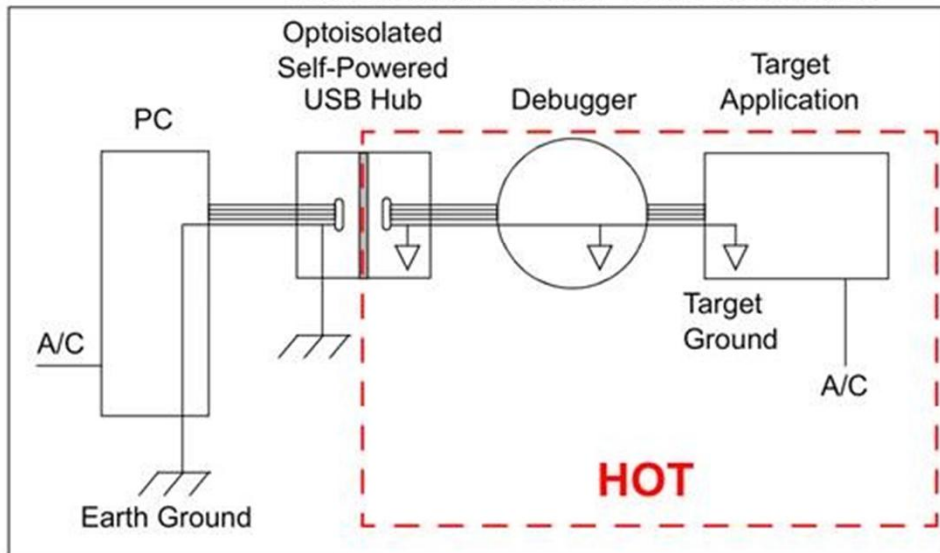
MPLAB[®] REAL ICE[™] Isolator

- | **Позволяет подключать высоковольтные устройства и с переменным током**
- | **Изоляция до 2.5KV**
- | **Подключение через кабель CAT5**
- | **Включает Performance Pak**



MPLAB[®] REAL ICE[™] Isolator

EXAMPLE DEBUGGER SETUP FOR NON-ISOLATED AC POWER SYSTEMS

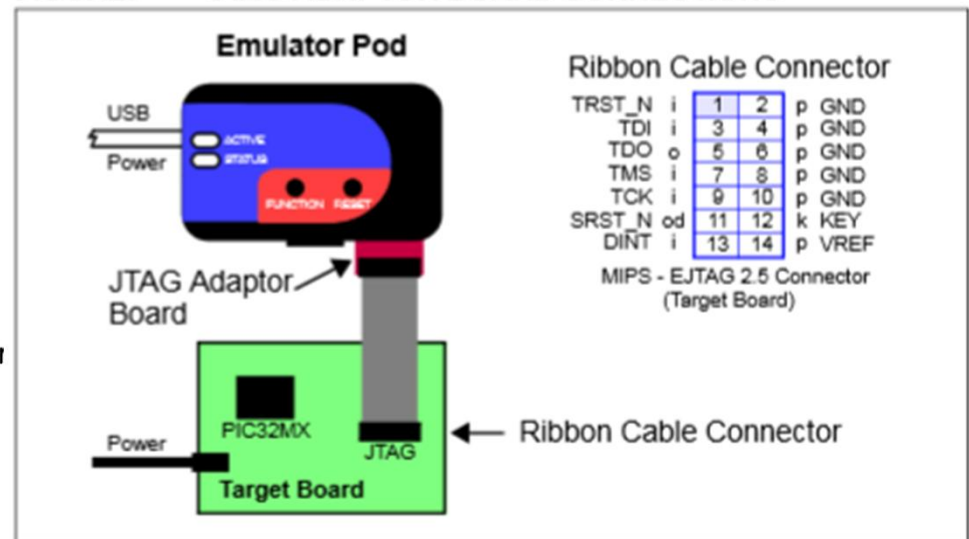


Подключение PIC32 через 4-х проводный JTAG

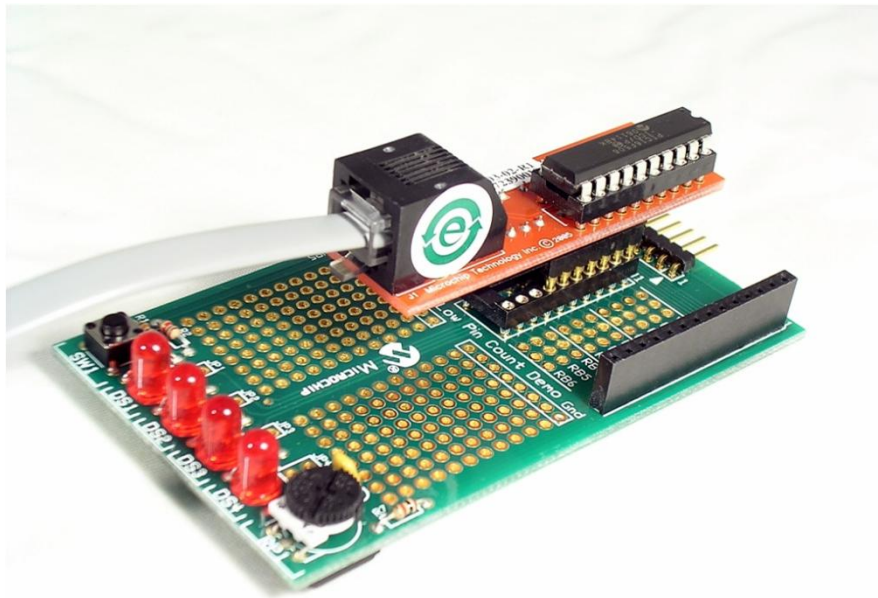
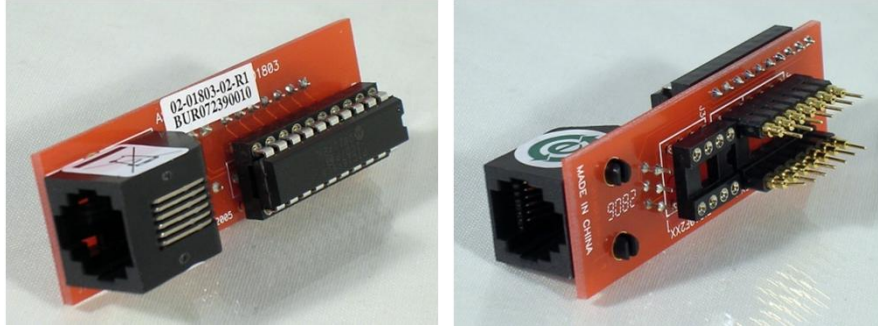


MPLAB® REAL ICE™ In-Circuit Emulator JTAG Adapter
(Part # AC244007)

FIGURE: JTAG ADAPTOR BOARD CONNECTIONS



Debug Headers



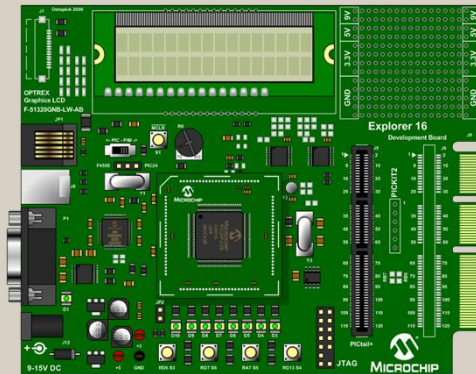
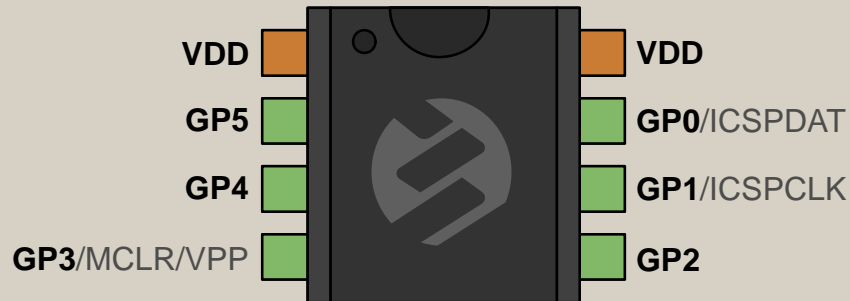
- ▮ **Позволяют отлаживаться когда:**
 - ▮ Нет доступных выводов
 - ▮ МК не имеет возможностей по отладке



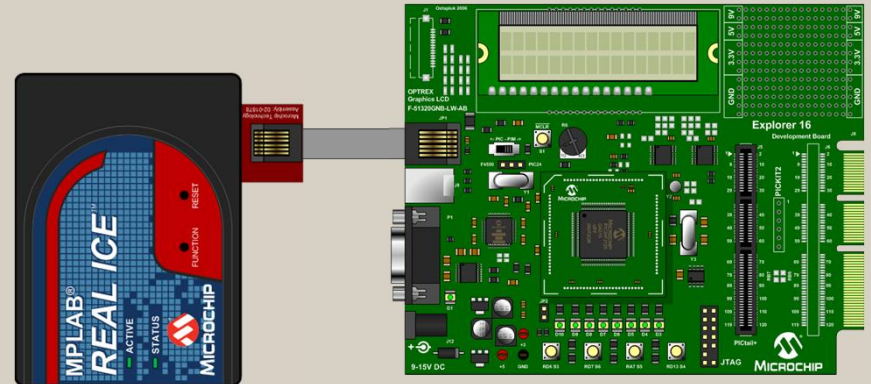
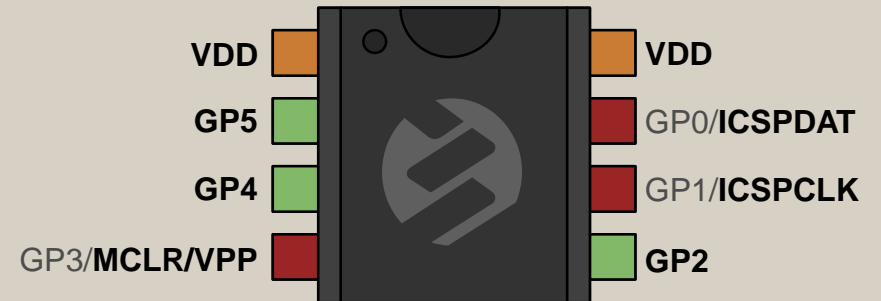
В MPLAB® X IDE выбирать МК, который вы хотите использовать, Не тот, который установлен в Header!

Debug Headers

Pin-out as seen by the application

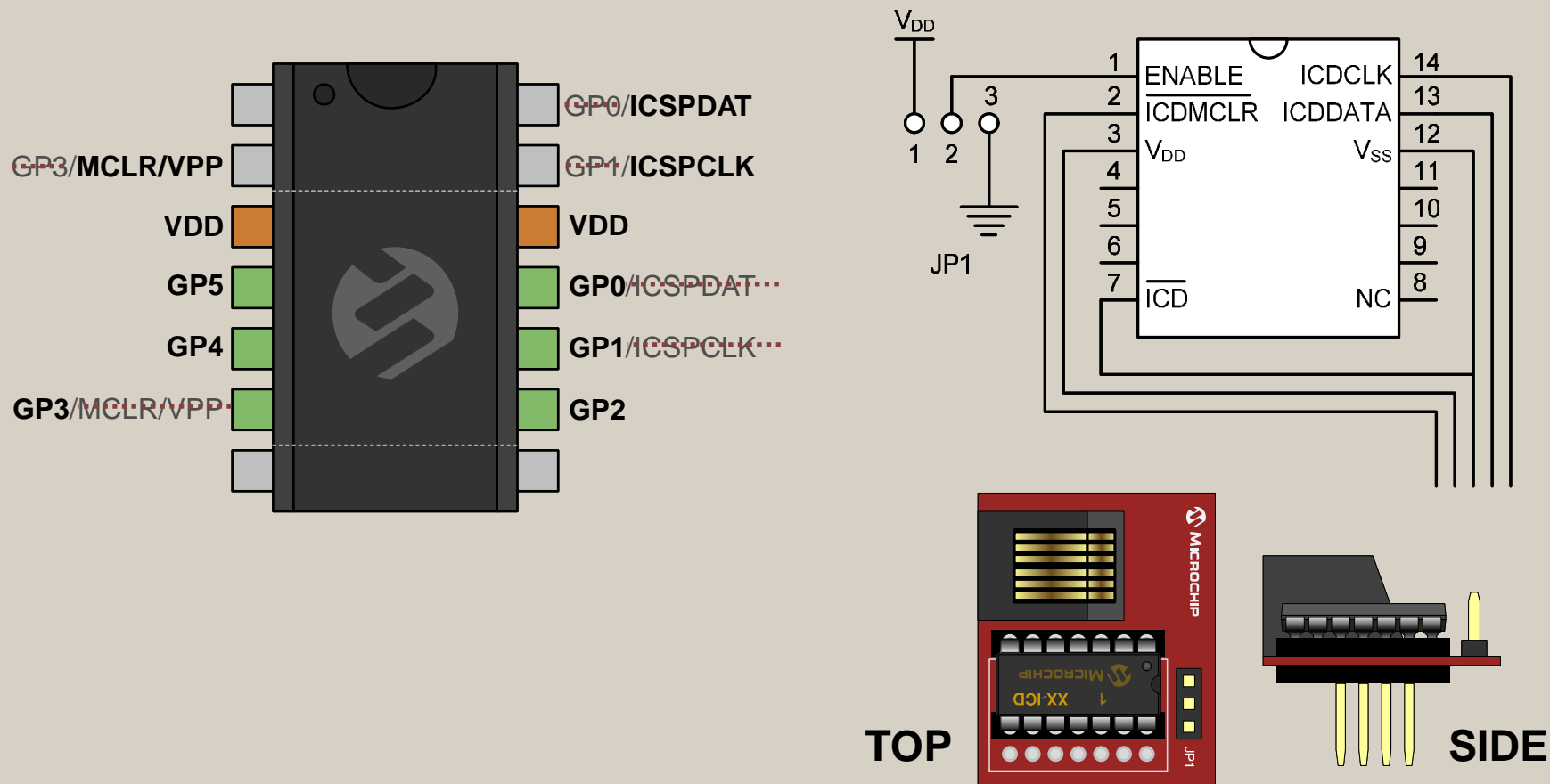


Pin-out as seen by the application with debugger connected

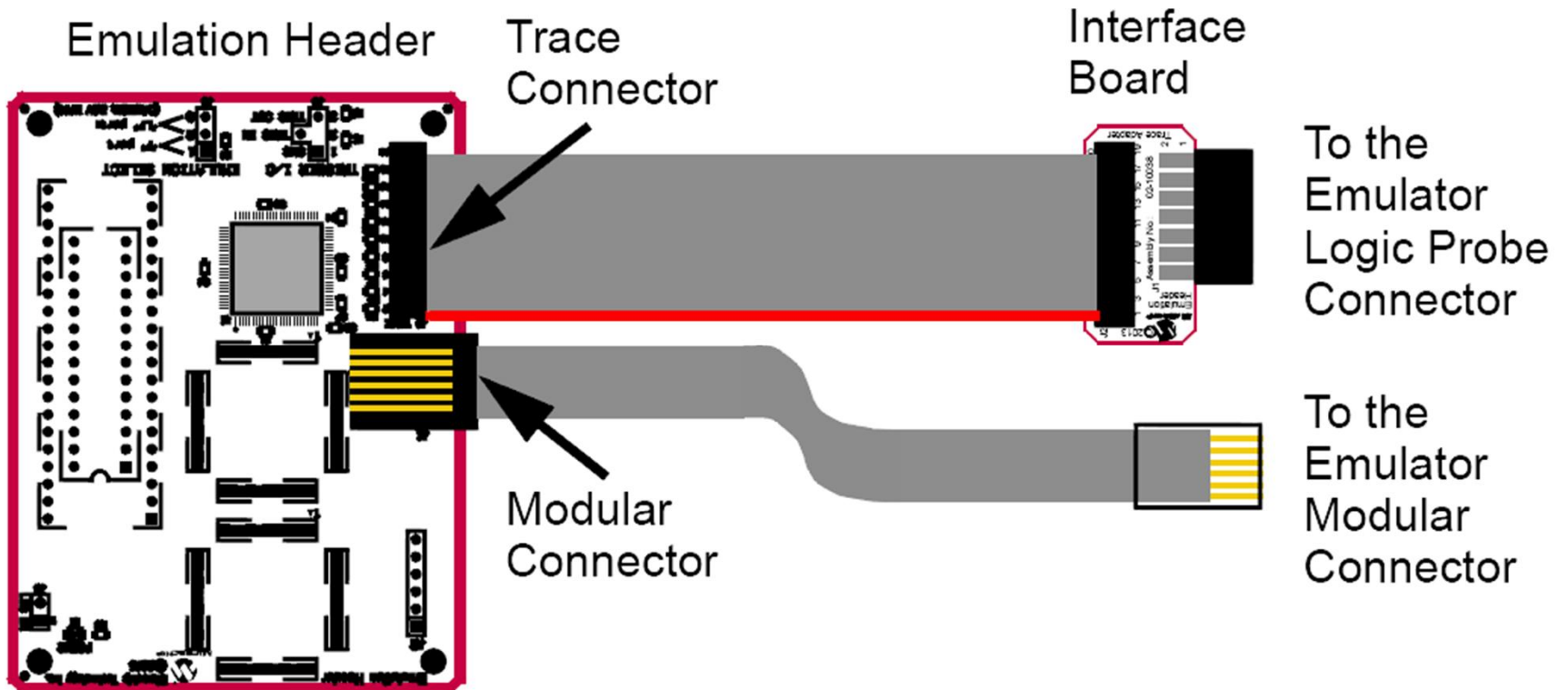


Debug Headers

Pin-out as seen by the application with debugger connected through a header



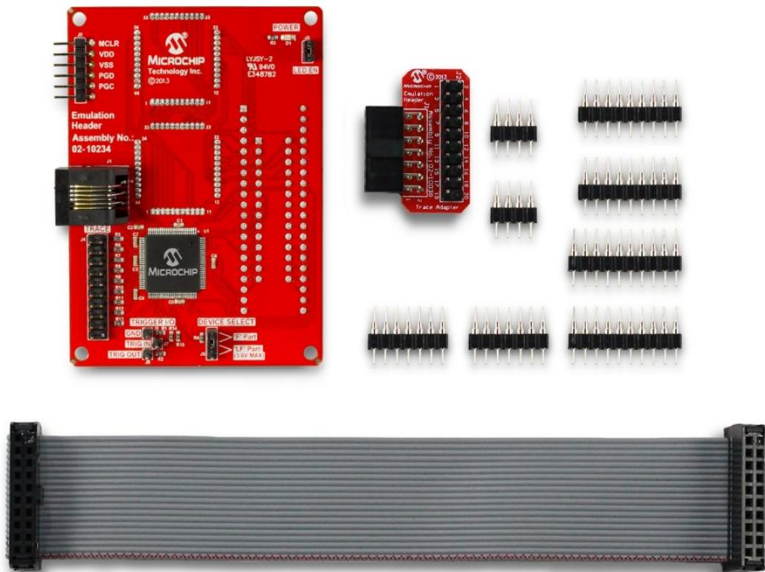
Processor Extension Pak (PEP)



Emulation Extension Pak (EEP)

- | **Подобно debug header но больше возможностей по отладке (PIC16F1xxx)**
 - | Real-time аппаратная трассировка выполнения команд под MPLAB® REAL ICE™
 - | Мониторинг в реальном времени 32-х регистров под MPLAB REAL ICE
 - | Аппаратные точки останова по адресу/данным (32 макс)
 - | Доступ к аппаратному стеку
 - | Показывает предыдущее состояние счетчика команд (PC)
 - | Внешние триггеры

Emulation Extension Pak (EEP)



**PIC16F1829-ME2 Emulation Extension Pak
(Part # AC244063)**

**AC244055 (PIC16F1939-ME) эмулирует:
PIC16(L)F1933/4/6/7/8/9**

**AC244063 (PIC16F1829-ME2) эмулирует:
PIC12(L)F1822/40
PIC16(L)F1823/4/5/6/7/8/9
PIC16(L)F1847**

**AC244064 (PIC16F1789-ME2) эмулирует:
PIC16(L)F1782/3/4/5/6/7/8/9**

**AC244066 (PIC16F1619-ME2) эмулирует:
PIC12(L)F1612
PIC16(L)F1613/4/5/8/9**

- | **Промышленный программатор**
- | **Автономный режим**
- | **Программирование в соquete или внутрисхемно**
- | **RS232 или USB**
- | **Три режима**
 - | **Полный контроль от ПК**
 - | **Safe mode для безопасности данных**
 - | **Автономный режим**
- | **Поддержка карт памяти Secure Digital (SD) и Multimedia Card (MMC)**



Development Tools Selector



- | **Показывает все отладочные платы**
- | **Эмуляторы/Отладчики**
 - | Возможности по отладке, число точек останова и т.д.
 - | Поддерживаемые headers/emulation extension packs
 - | **Дополнительные поддерживаемые возможности**
 - | **Требования и опции**
- | **Программаторы**
 - | Показывает названия PM3 socket для различных корпусов
- | **Домашняя страница Development Tools Selector**

Find the best Development Tool
for your embedded solution here



| www.microchip.com/dts



MICROCHIP

MASTERS 2015

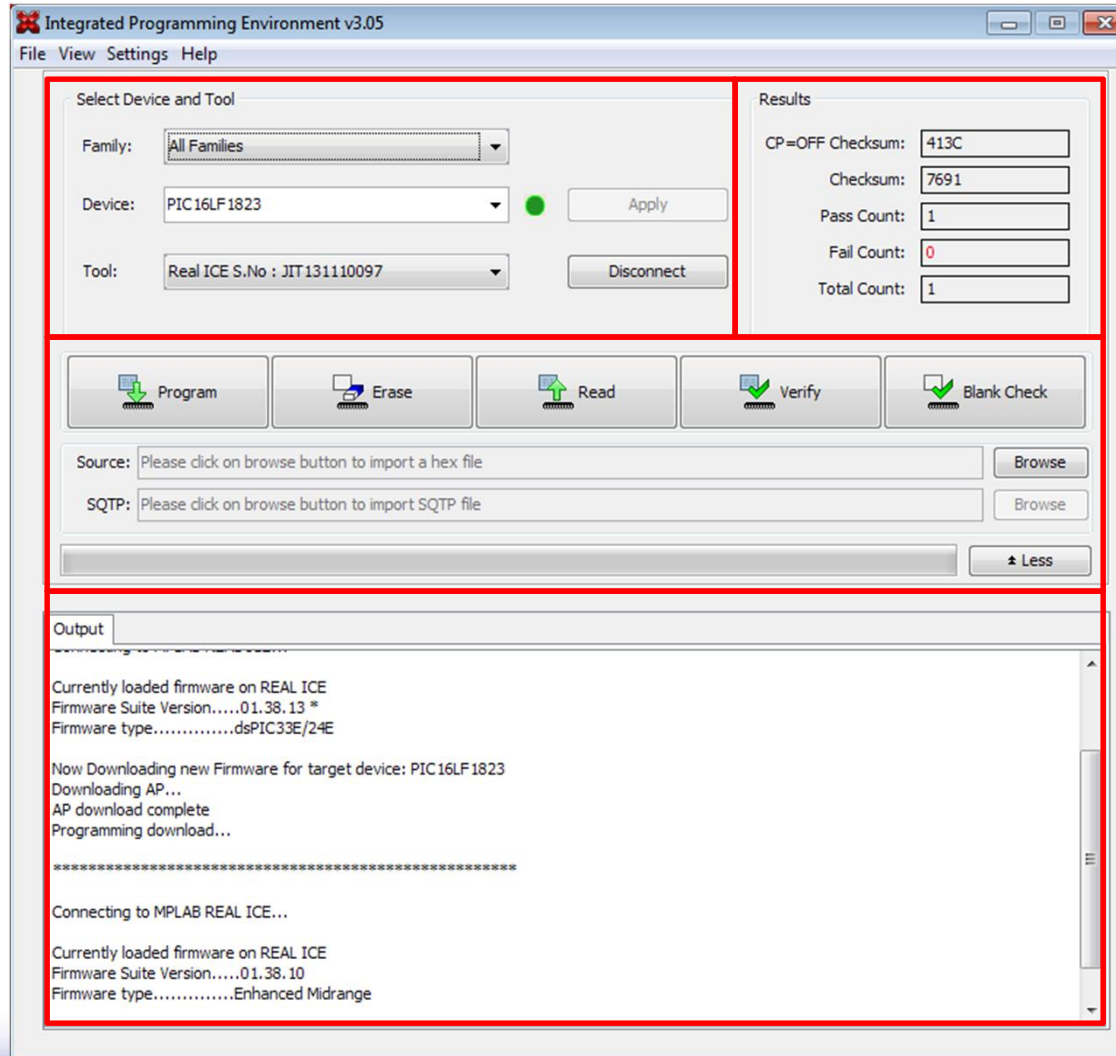
Инструментарий для производства

Programming and Scripting

- | **MPLAB® X IDE**
 - | Платформа для разработки
 - | Инструмент для отладки
- | **Для производства более подходят**
 - | MPLAB IPE
 - | IPE Command Line
- | **Scripting Tools**
 - | MDB Command Line
 - | SDK

MPLAB® IPE

IPE = среда программирования



Свойства IPE

- ┆ Просто в использовании, быстрая установка
- ┆ Файлы окружения
- ┆ Сериализация (SQTP)
- ┆ Поддержка всех программаторов Microchip
- ┆ Сделано под разные операционные системы
- ┆ Расширенный режим

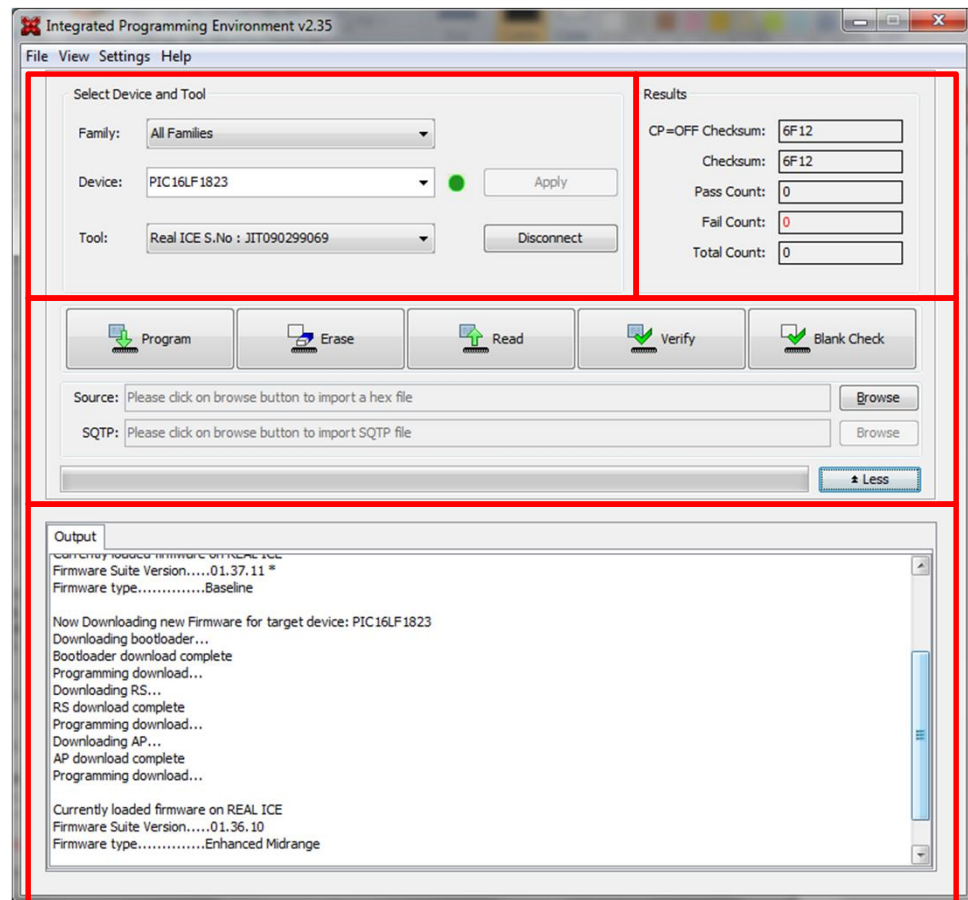
Режимы

- | **Расширенный режим**
 - Доступ под паролем
 - Настраиваемый интерфейс
 - Может ограничивать число программирований
 - Контроль экспорта/импорта прошивок
 - Позволяет генерировать файлы сериализации и окружения

Обзор IPE

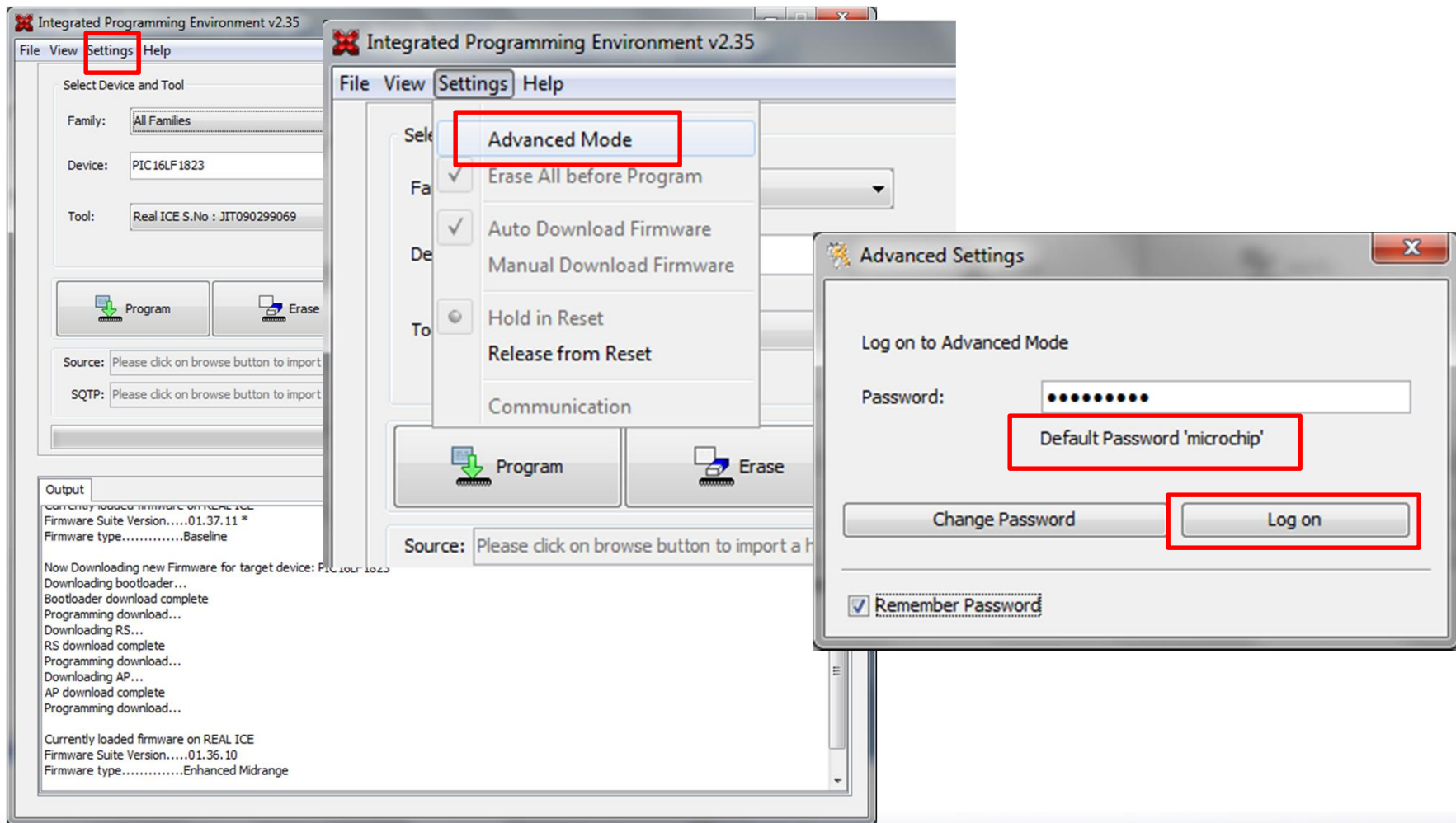
Production Mode:

- **Выбор МК, программатора**
- **Основные операции**
 - Program, Erase, Verify, Load Hex...
- **Окно памяти**
- **Окно отчетов**



Обзор: Advanced Mode

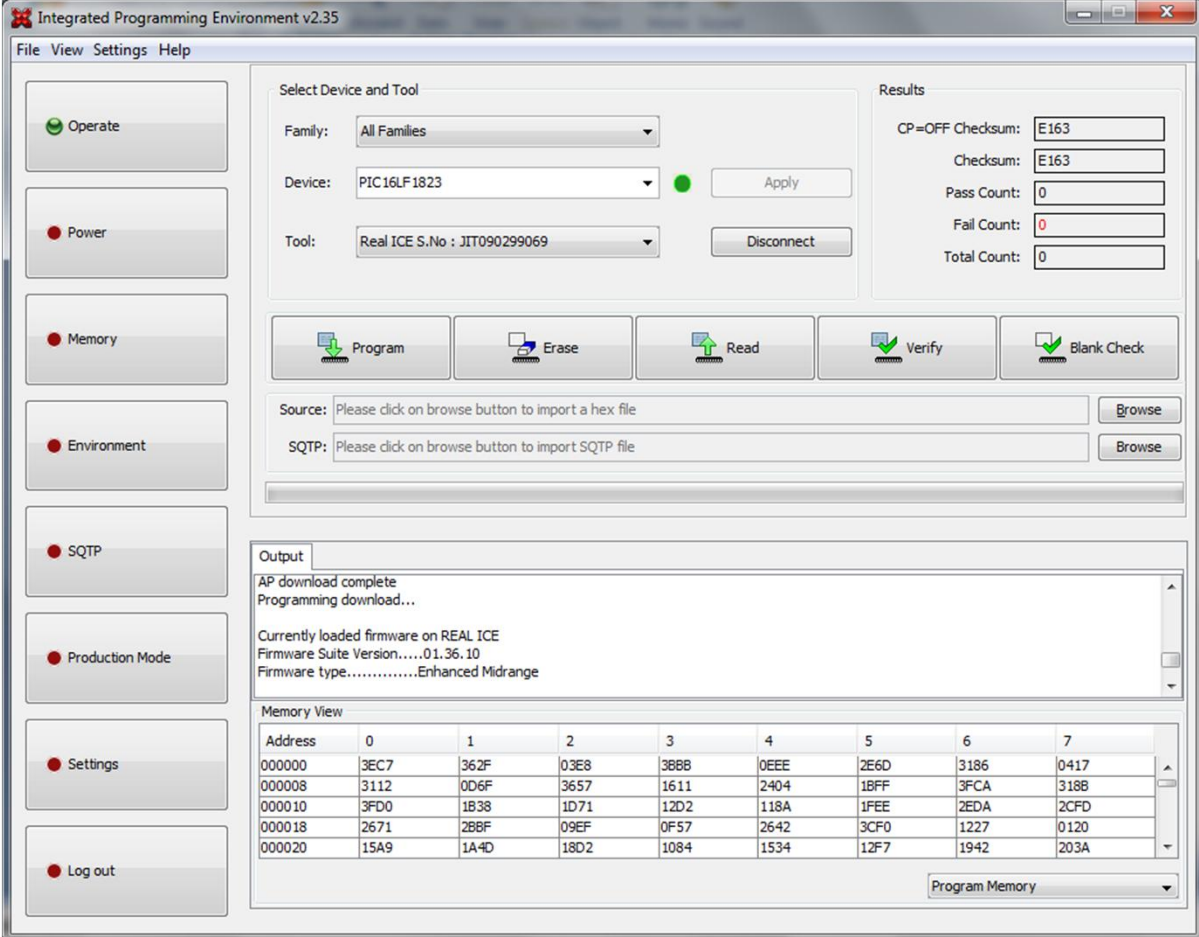
Вход в режим:



Обзор: Advanced Mode

“Operate”:

- Доступны все опции



Integrated Programming Environment v2.35

File View Settings Help

Operate (selected)

Power

Memory

Environment

SQTP

Production Mode

Settings

Log out

Select Device and Tool

Family: All Families

Device: PIC16LF1823

Tool: Real ICE S.No : JIT090299069

Apply

Disconnect

Results

CP=OFF Checksum: E163

Checksum: E163

Pass Count: 0

Fail Count: 0

Total Count: 0

Program Erase Read Verify Blank Check

Source: Please click on browse button to import a hex file

SQTP: Please click on browse button to import SQTP file

Output

AP download complete
Programming download...

Currently loaded firmware on REAL ICE
Firmware Suite Version.....01.36.10
Firmware type.....Enhanced Midrange

Memory View

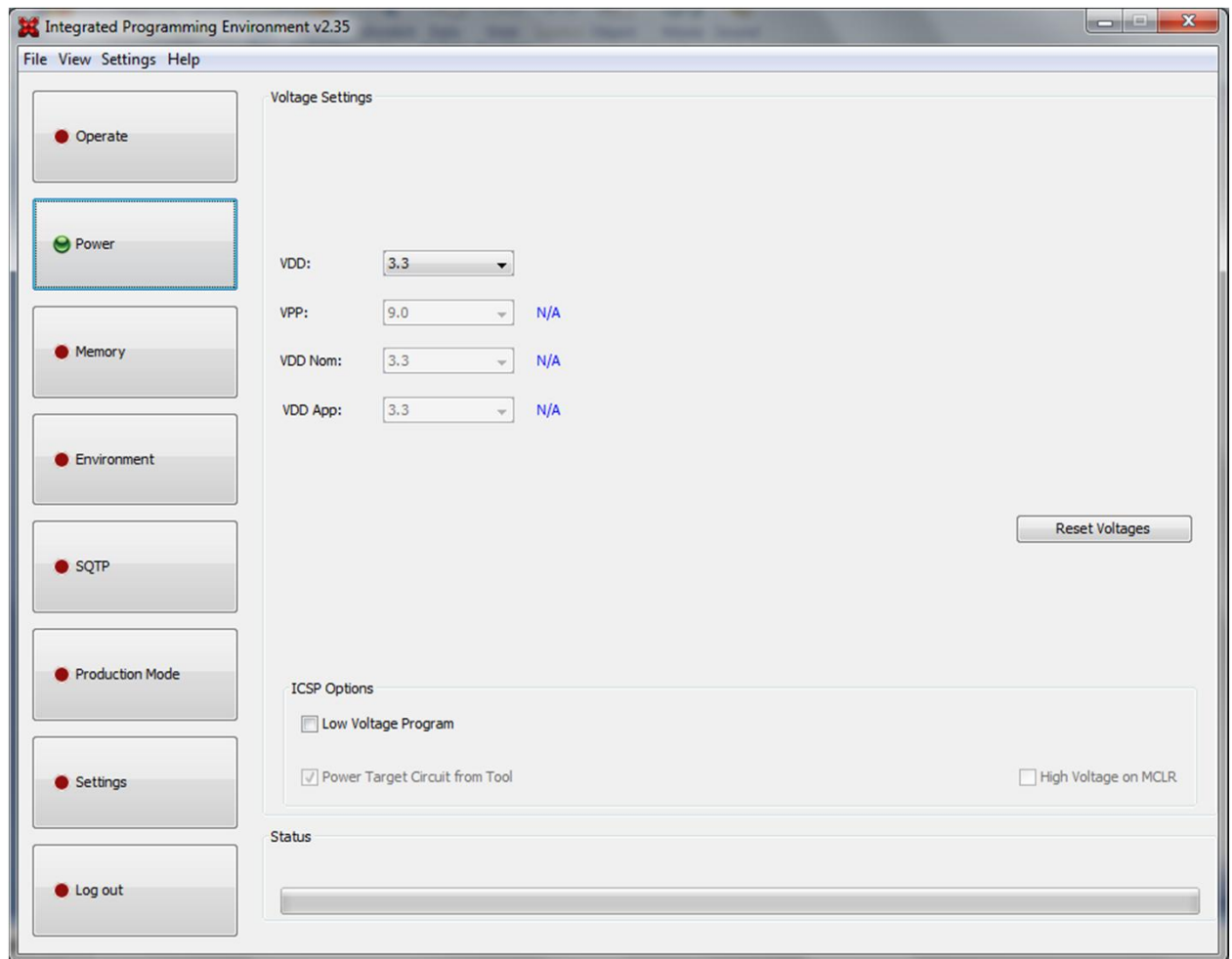
| Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---------|------|------|------|------|------|------|------|------|
| 000000 | 3EC7 | 362F | 03E8 | 38BB | 0EEE | 2E6D | 3186 | 0417 |
| 000008 | 3112 | 0D6F | 3657 | 1611 | 2404 | 1BFF | 3FCA | 318B |
| 000010 | 3FD0 | 1838 | 1D71 | 12D2 | 118A | 1FEE | 2EDA | 2CFD |
| 000018 | 2671 | 2BBF | 09EF | 0F57 | 2642 | 3CF0 | 1227 | 0120 |
| 000020 | 15A9 | 1A4D | 18D2 | 1084 | 1534 | 12F7 | 1942 | 203A |

Program Memory

Обзор: Advanced Mode

“Power” :

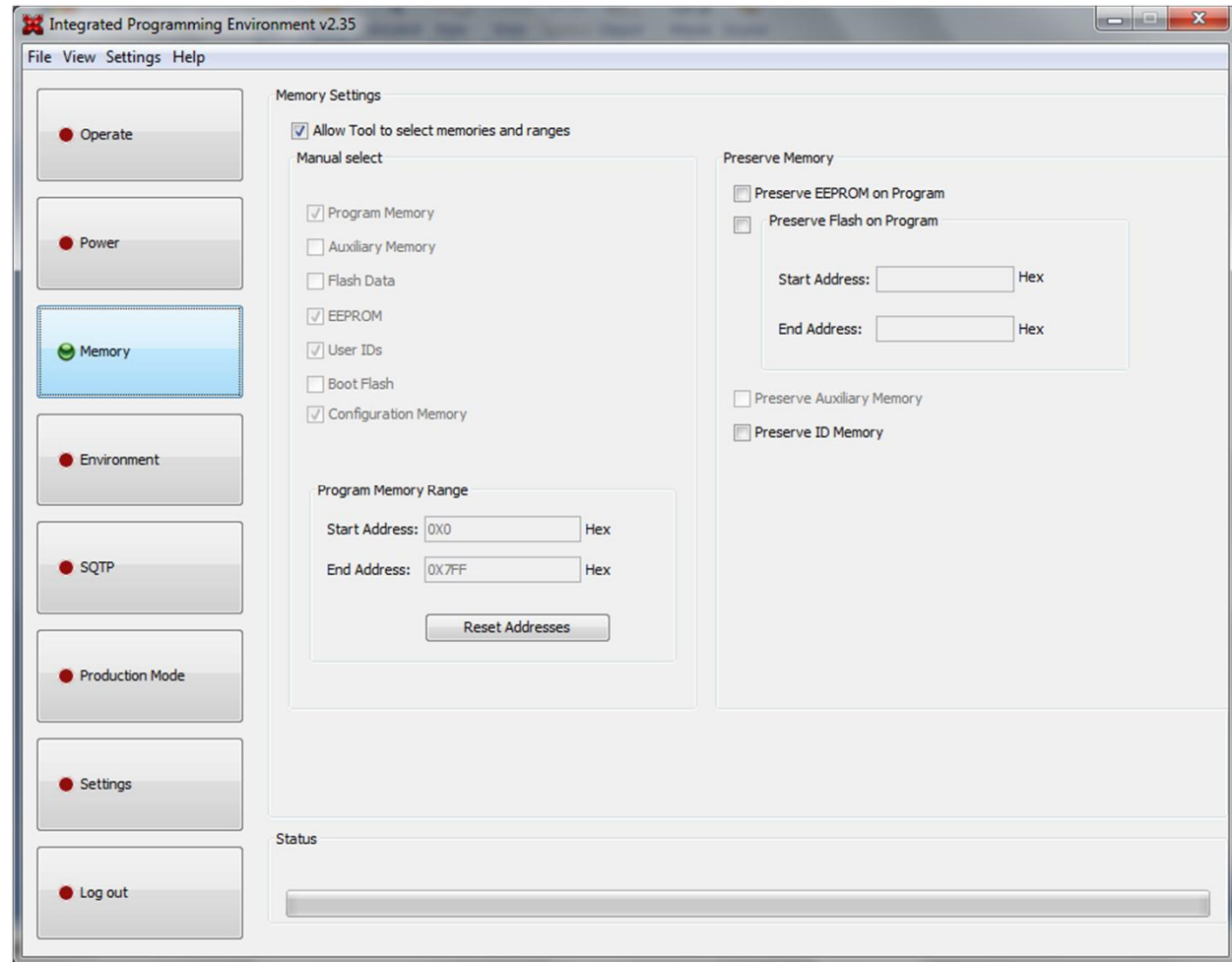
- Установка VDD
- Да/Нет питание от программатора
- Разрешение низковольтного программирования



Обзор: Advanced Mode

“Memory”:

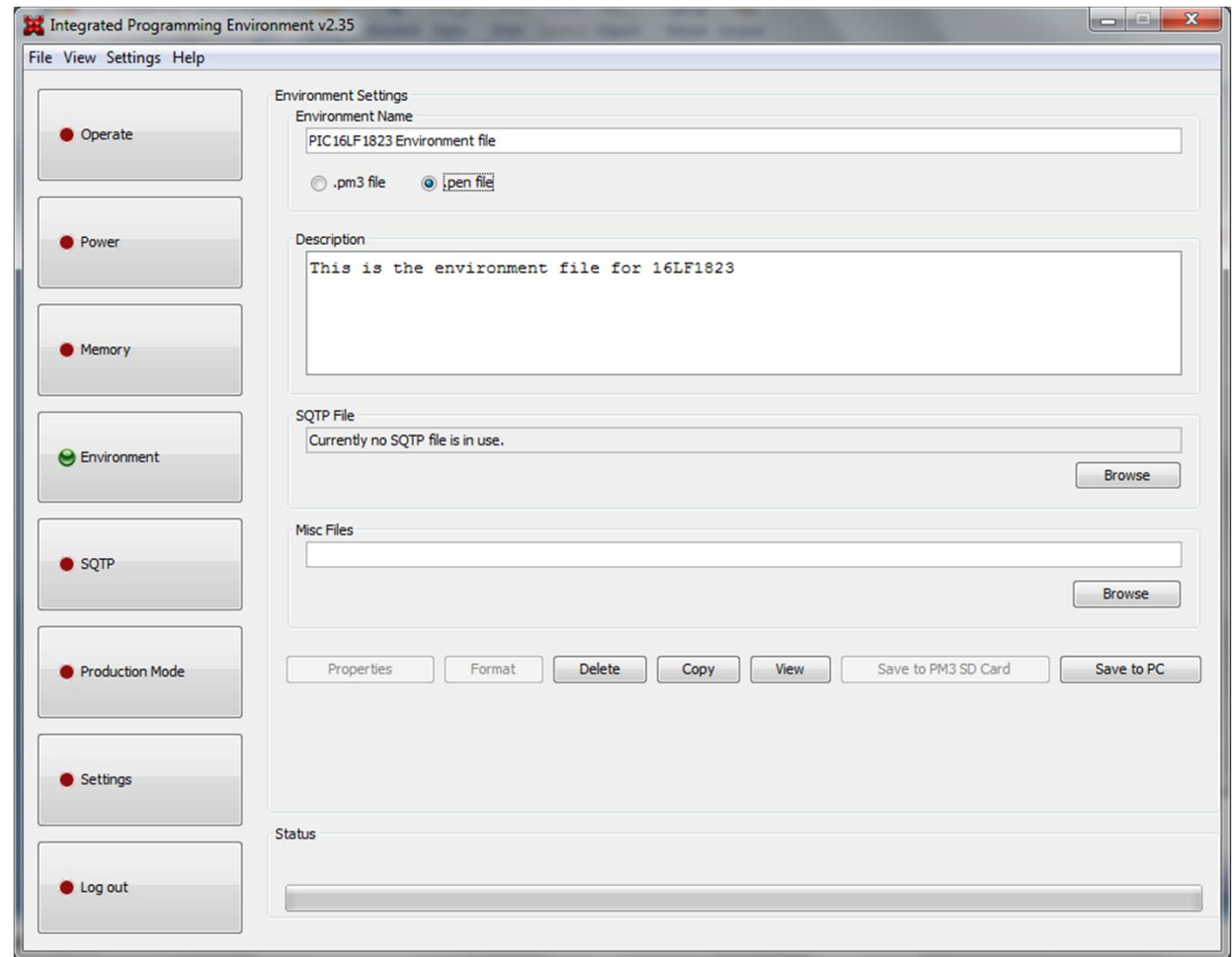
- Диапазон программирования
- Выбор области программирования
- Резервирование памяти
- Резервирование EEPROM



Обзор: Advanced Mode

“Environment”

- | **Создание/Запись окружения на ПК или SD карту для PM3**
 - | Все поддерживаемые программаторы поддерживают Окружение
- | **.pm3 файлы для PM3**
- | **Работает с пред. версиями окружения для PM3 от MPLAB® IDE v8.xx**
- | **.rep файлы для других - RI, MPLAB ICD 3, PK3**

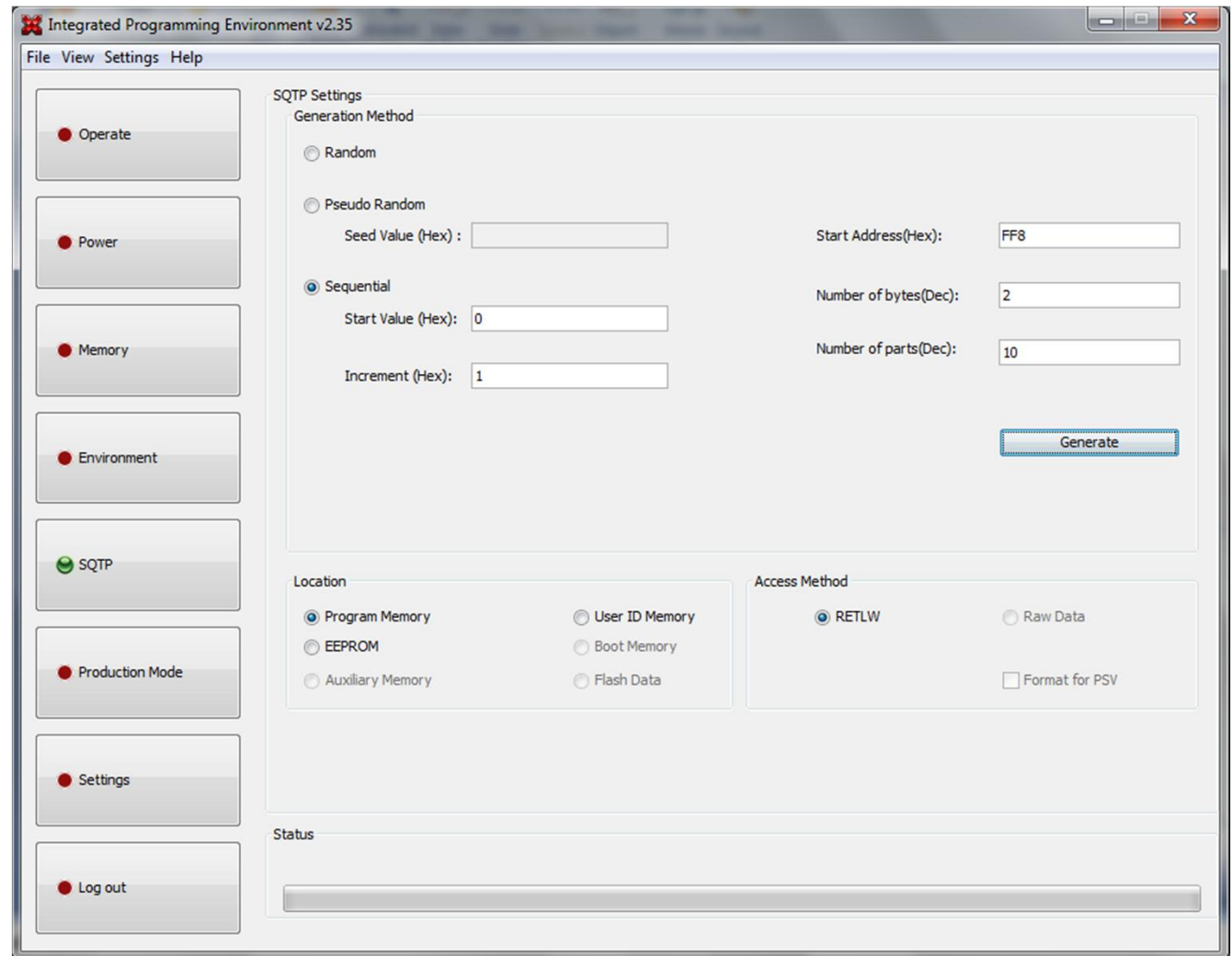


Открытие MPLAB IPE с сохраненными настройками Окружения

Обзор: Advanced Mode

“SQTP”

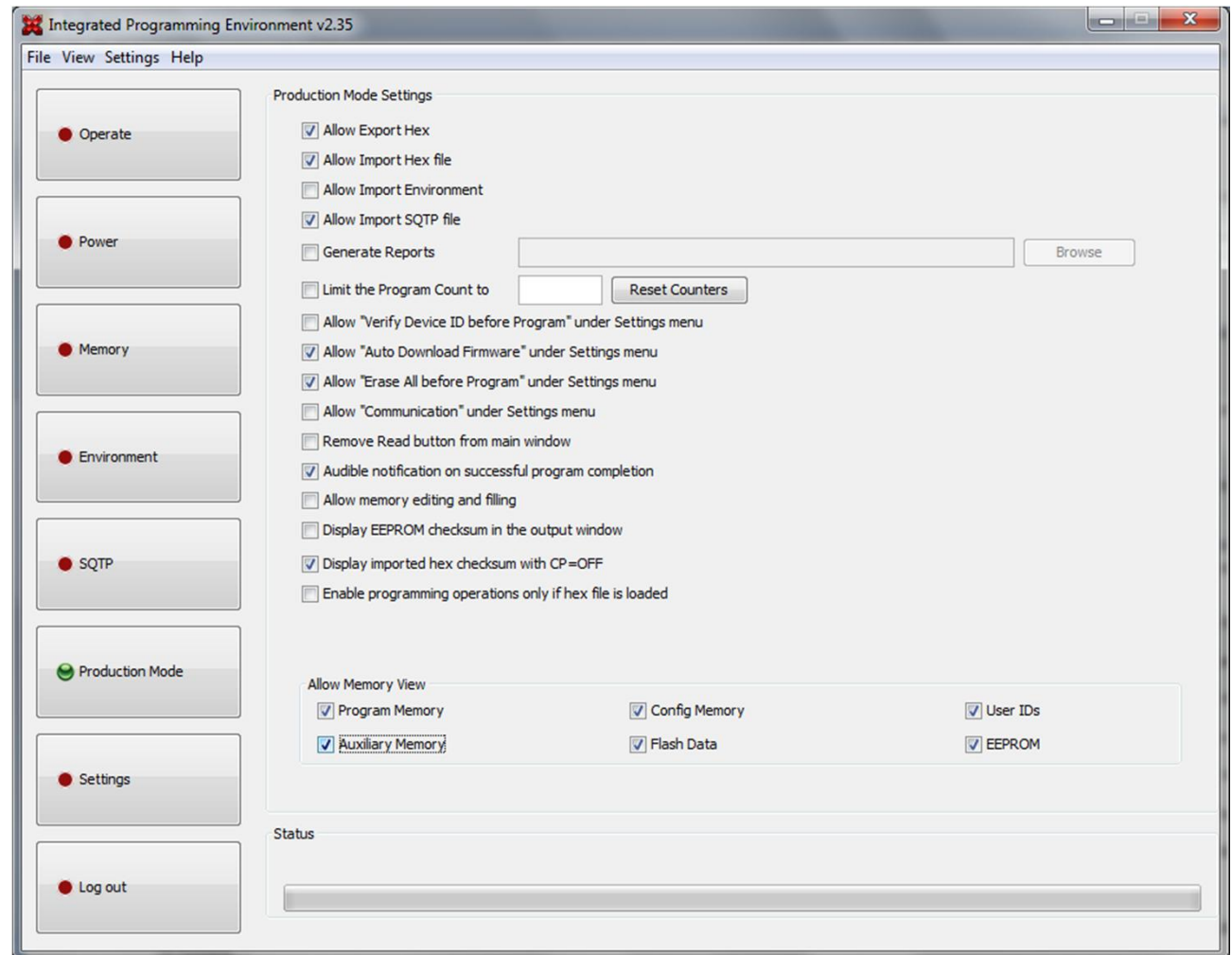
- | SQTP .num
файл опций
- | Те же
настройки как
MPLAB® IDE
v8.xx



Обзор: Advanced Mode

“Production Mode”

- | Настройка что доступно в «обычном» режиме
- | Формирование отчетов (Log File)
- | Ограничение числа прошивок
- | Возможность добавления звука ‘program complete’
- | Доступ к редактированию памяти
- | Доступ к просмотру памяти



Обзор: Advanced Mode

“Settings Mode”

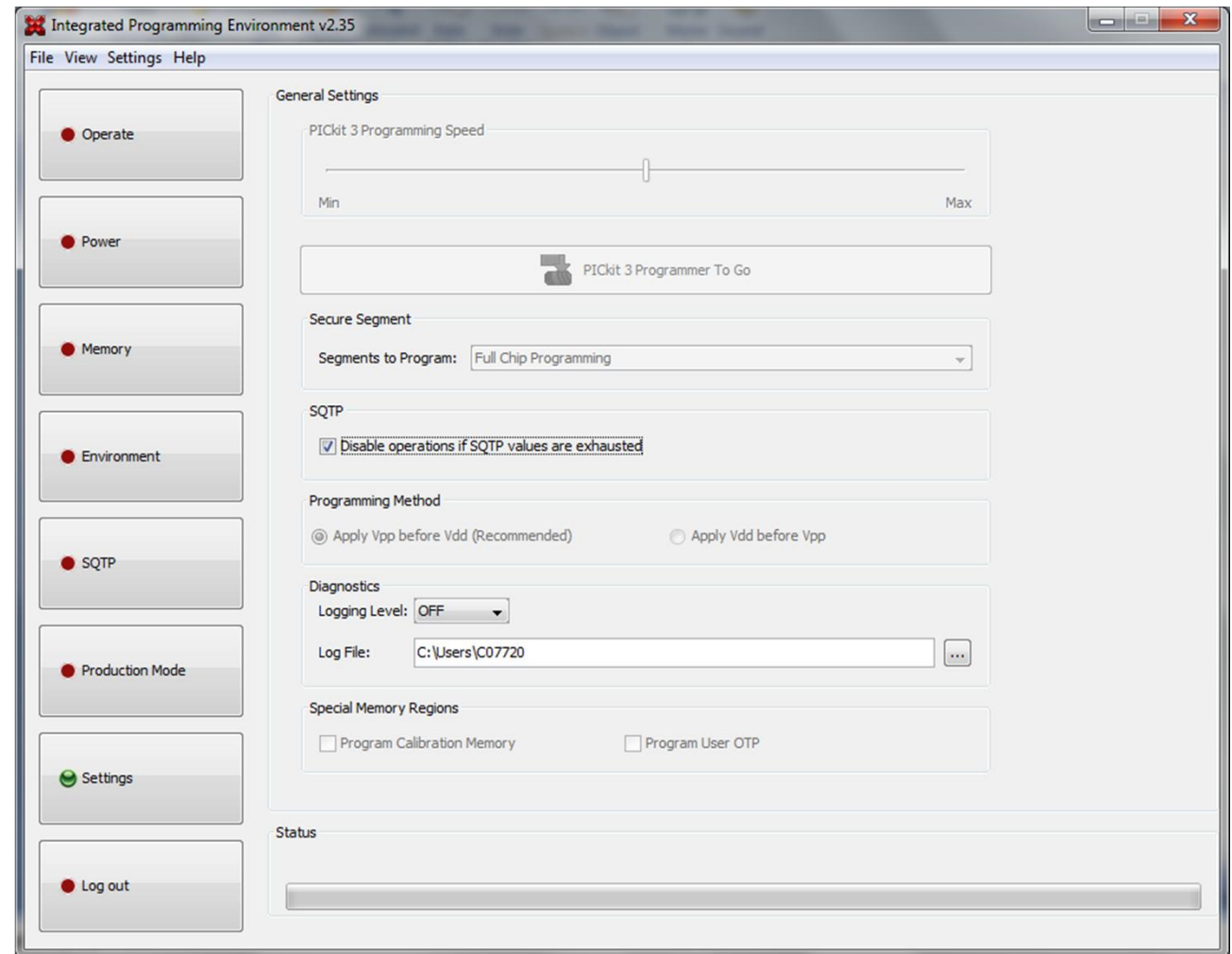
Скорость
программирования
PICkit 3

PICkit 3
Programmer To
Go

Secure Segment

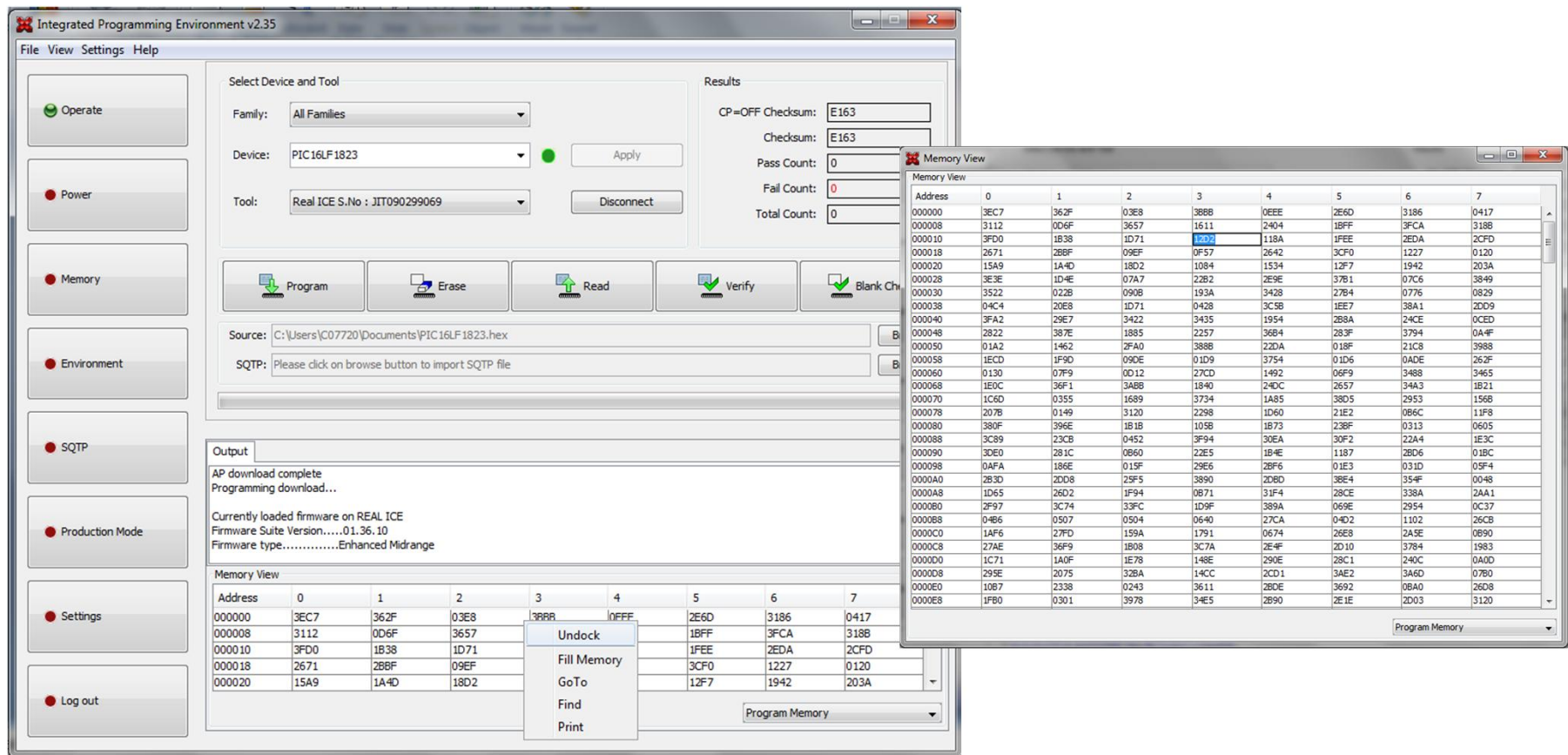
Остановка
программирования
если SQTP
исчерпан

Разрешение
логгирования и
генерации лога



Обзор IPE

Возможность редактирования памяти



The screenshot displays the Integrated Programming Environment (IPE) v2.35 interface. The main window shows the 'Select Device and Tool' section with the following settings:

- Family: All Families
- Device: PIC16LF1823
- Tool: Real ICE S.No : JIT090299069

The 'Results' section shows:

- CP=OFF Checksum: E163
- Checksum: E163
- Pass Count: 0
- Fail Count: 0
- Total Count: 0

The 'Memory View' window is open, displaying a table of memory addresses and their corresponding values. The table is as follows:

| Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---------|------|------|------|------|------|------|------|------|
| 000000 | 3EC7 | 362F | 03E8 | 38BB | 0EEE | 2E6D | 3186 | 0417 |
| 000008 | 3112 | 0D6F | 3657 | 1611 | 2404 | 1BFF | 3FCA | 3188 |
| 000010 | 3FD0 | 1B38 | 1D71 | 1202 | 118A | 1FEE | 2EDA | 2CFD |
| 000018 | 2671 | 2BBF | 09EF | 0F57 | 2642 | 3CF0 | 1227 | 0120 |
| 000020 | 15A9 | 1A4D | 18D2 | 1084 | 1534 | 12F7 | 1942 | 203A |
| 000028 | 3E3E | 1D4E | 07A7 | 2282 | 2E9E | 3781 | 07C6 | 3849 |
| 000030 | 3522 | 022B | 090B | 193A | 3428 | 2784 | 0776 | 0829 |
| 000038 | 04C4 | 20E8 | 1D71 | 0428 | 3C5B | 1EE7 | 38A1 | 2DD9 |
| 000040 | 3FA2 | 29E7 | 3422 | 3435 | 1954 | 2B8A | 24CE | 0CED |
| 000048 | 2822 | 387E | 1885 | 2257 | 3684 | 283F | 3794 | 0A4F |
| 000050 | 01A2 | 1462 | 2FA0 | 3888 | 22DA | 018F | 21C8 | 3988 |
| 000058 | 1ECD | 1F9D | 090E | 01D9 | 3754 | 01D6 | 0ADE | 262F |
| 000060 | 0130 | 07F9 | 0D12 | 27CD | 1492 | 06F9 | 3488 | 3465 |
| 000068 | 1E0C | 36F1 | 3A8B | 1840 | 24DC | 2657 | 34A3 | 1B21 |
| 000070 | 1C6D | 0355 | 1689 | 3734 | 1A85 | 38D5 | 2953 | 1568 |
| 000078 | 2078 | 0149 | 3120 | 2298 | 1D40 | 21E2 | 0B6C | 11F8 |
| 000080 | 380F | 396E | 1B1B | 105B | 1B73 | 238F | 0313 | 3605 |
| 000088 | 3C89 | 23CB | 0452 | 3F94 | 30EA | 30F2 | 22A4 | 1E3C |
| 000090 | 3DE0 | 281C | 0B60 | 22E5 | 1B4E | 1187 | 2B06 | 01BC |
| 000098 | 04FA | 186E | 015F | 29E6 | 28F6 | 01E3 | 031D | 05F4 |
| 0000A0 | 283D | 2D08 | 25F5 | 3890 | 2D8D | 38E4 | 354F | 0048 |
| 0000A8 | 1D65 | 26D2 | 1F94 | 0B71 | 31F4 | 28CE | 338A | 2AA1 |
| 0000B0 | 2F97 | 3C74 | 33FC | 1D9F | 389A | 069E | 2954 | 0C37 |
| 0000B8 | 04B6 | 0507 | 0504 | 0640 | 27CA | 04D2 | 1102 | 26CB |
| 0000C0 | 1AF6 | 27FD | 159A | 1791 | 0674 | 26E8 | 2A5E | 0B90 |
| 0000C8 | 27AE | 36F9 | 1B08 | 3C7A | 2E4F | 2D10 | 3784 | 1983 |
| 0000D0 | 1C71 | 1A0F | 1E78 | 148E | 290E | 28C1 | 240C | 0A0D |
| 0000D8 | 295E | 2075 | 32BA | 14CC | 2CD1 | 3AE2 | 3A6D | 0780 |
| 0000E0 | 10B7 | 2338 | 0243 | 3611 | 2BDE | 3692 | 0BAA | 26D8 |
| 0000E8 | 1FB0 | 0301 | 3978 | 34E5 | 2B90 | 2E1E | 2D03 | 3120 |

The 'Memory View' window also includes a context menu with the following options: Undo, Fill Memory, GoTo, Find, and Print.

Command line tools

┆ MPLAB® IPE Command Line Interface (IPECMD)

- ┆ Позволяет автоматизировать производство
- ┆ Поддержка всех операций с программатором
- ┆ SQTP программирование
- ┆ Поддержка
 - ┆ PICkit3
 - ┆ ICD3
 - ┆ REAL ICE
 - ┆ PM3
- ┆ Кроссплатформенность

Command line tools *

- | **MPLAB® IPE Command Line Interface (IPECMD)**
 - | IPECMD это JAR файл
 - | Может использоваться в командном интерфейсе “java -jar”

- | **Пример программирования из под командной строки:**

```
>java -jar ipcmd.jar -P24FJ256GB106 -TPICD3 -F  
"c:/pic24.hex" -M
```

- | **Список команд можно получить вызвав встроенную помощь:**

```
>java -jar ipcmd.jar -?
```

Command line tools *

Предыдущие программы

- ReallCECMD.exe, PM3CMD.exe, PK3CMD.exe и ICD3CMD.exe так же включены в пакет MPLAB® X IDE
- Предоставляют обратную совместимость с Windows

Программирование с помощью REALICECMD.exe:

```
>REALICECMD -P18F67J50 -FC:\DemoCode.Hex -M
```



Без IDE

- | **Часто (иногда?) заказчики хотят использовать скриптовые инструменты**
 - | Для автоматизированной сборки проекта (MAKE)
 - | Предоставляется с MPLAB® X IDE
 - | Генерирует make-файлы без открытия IDE
 - | MDB Command Line
 - | Возможность проводить UNIT тесты
 - | Автоматизирование отладки (debug)
 - | MDB Core Scripting
 - | Интеграция с другими программами и оборудованием
 - | Дает возможность тестирования железа с программным управлением

Project 'make file' generator *

- ┆ **Поставляется с MPLAB® X IDE**
- ┆ **Генерирование 'Make' файлов без запуска IDE**
- ┆ **Находится в bin директории**
 - ┆ `<installpath>\MPLABX\mplab_ide\bin\prjMakefileGenerator.bat`

*Make File Generator

I Онлайн помощь

I Запустить без аргументов или с -help:

```
$ ./prjMakefilesGenerator.sh -help
```

```
prjMakefilesGenerator [-help] [-v] [project_path[@config_name]*]+
```

<project_path> - path to the MPLAB-X project in the file system

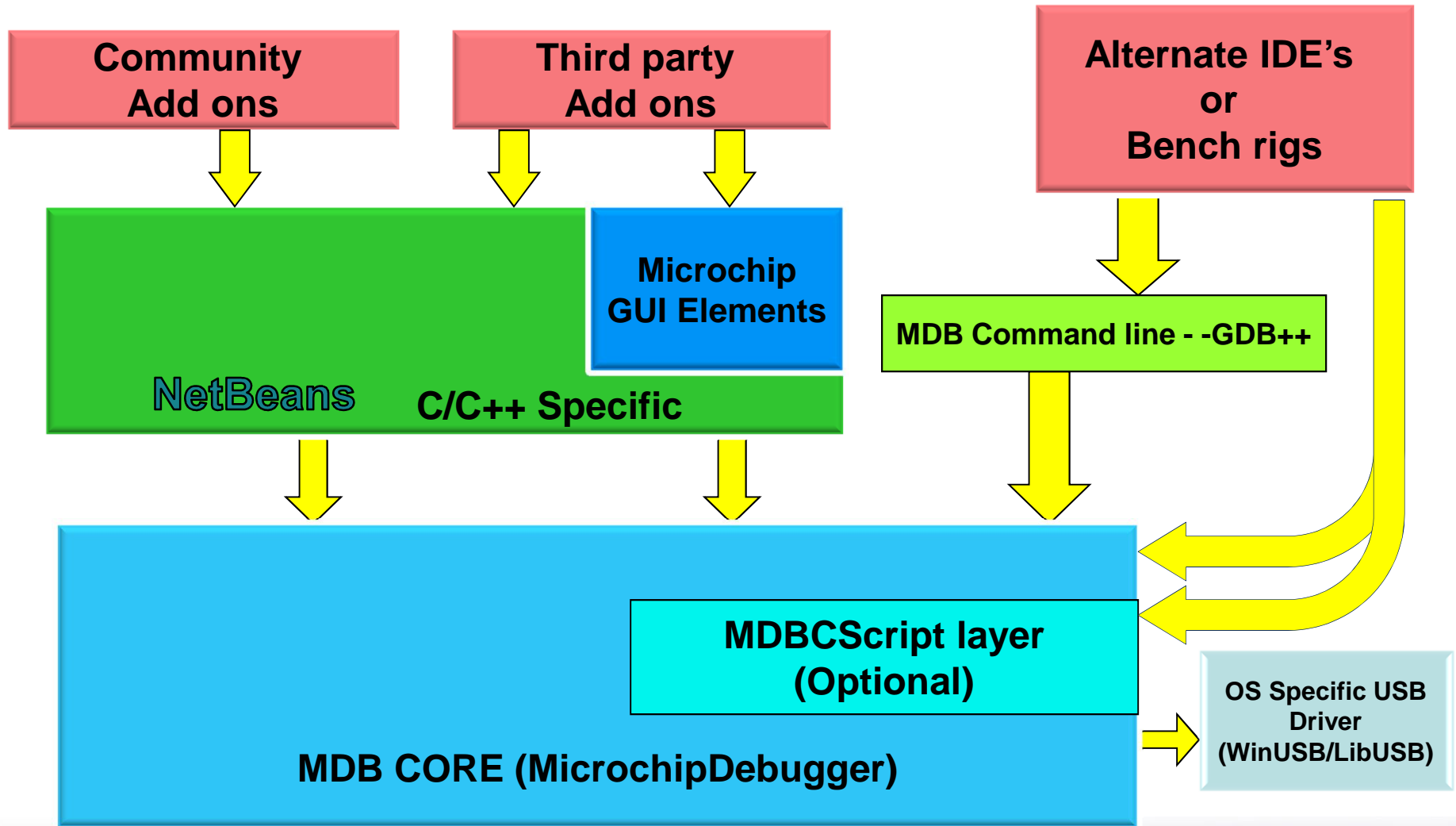
[config_name] - (optional)

name of a build configuration to generate the makefile for. If missing, the makefiles are generated for all the build configurations.

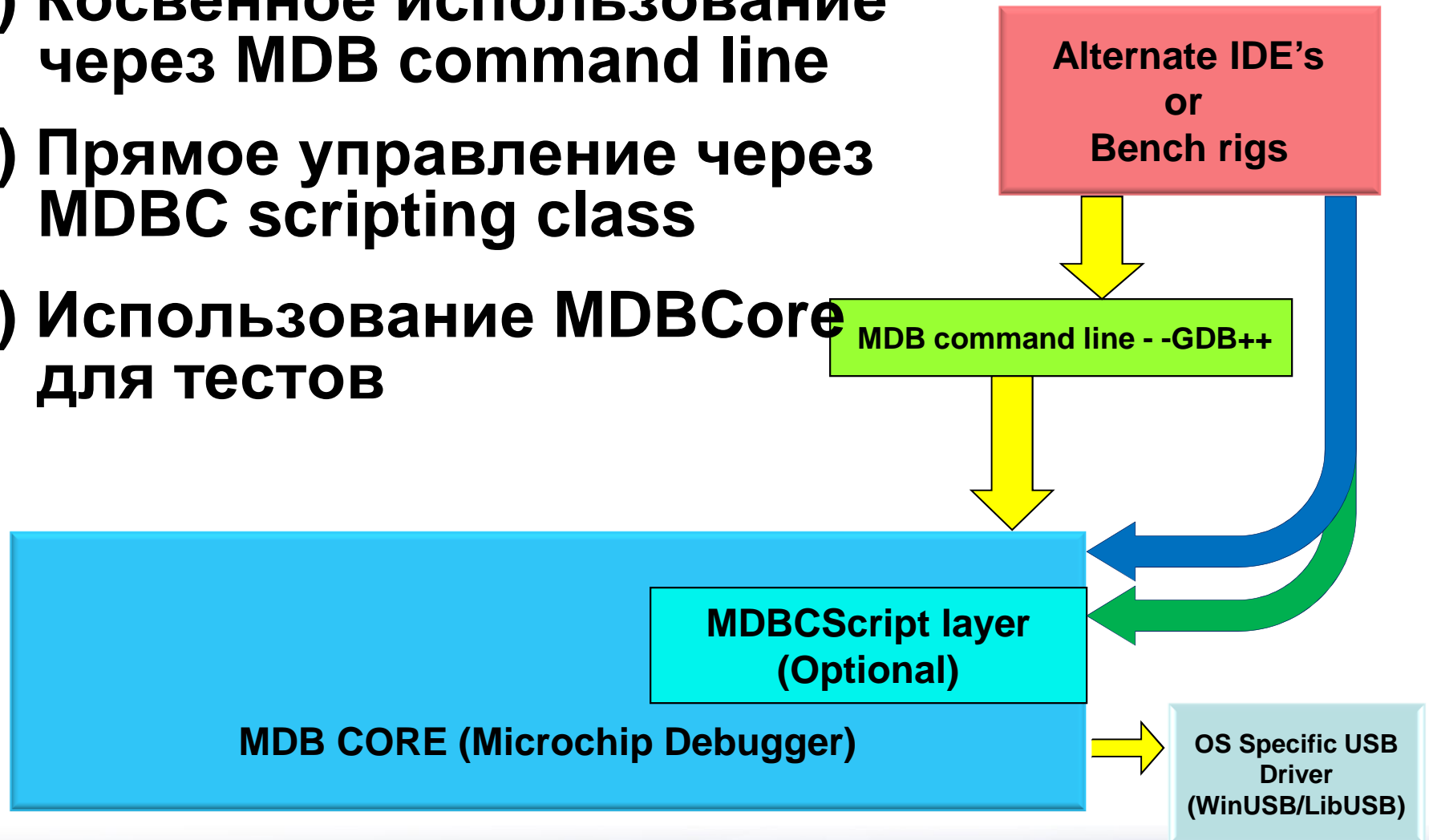
-help - displays this help screen.

-v - verbose processing.

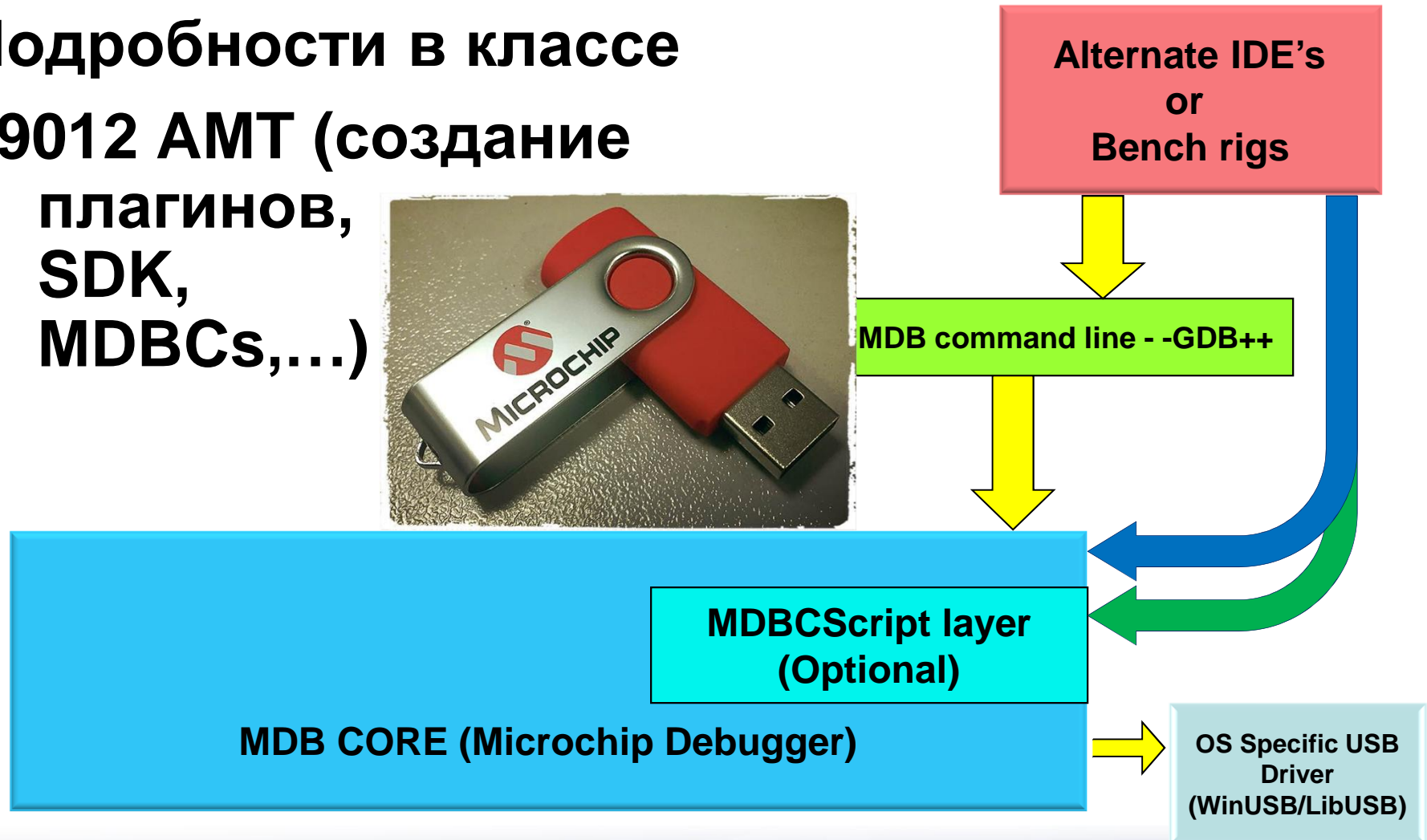
Архитектура



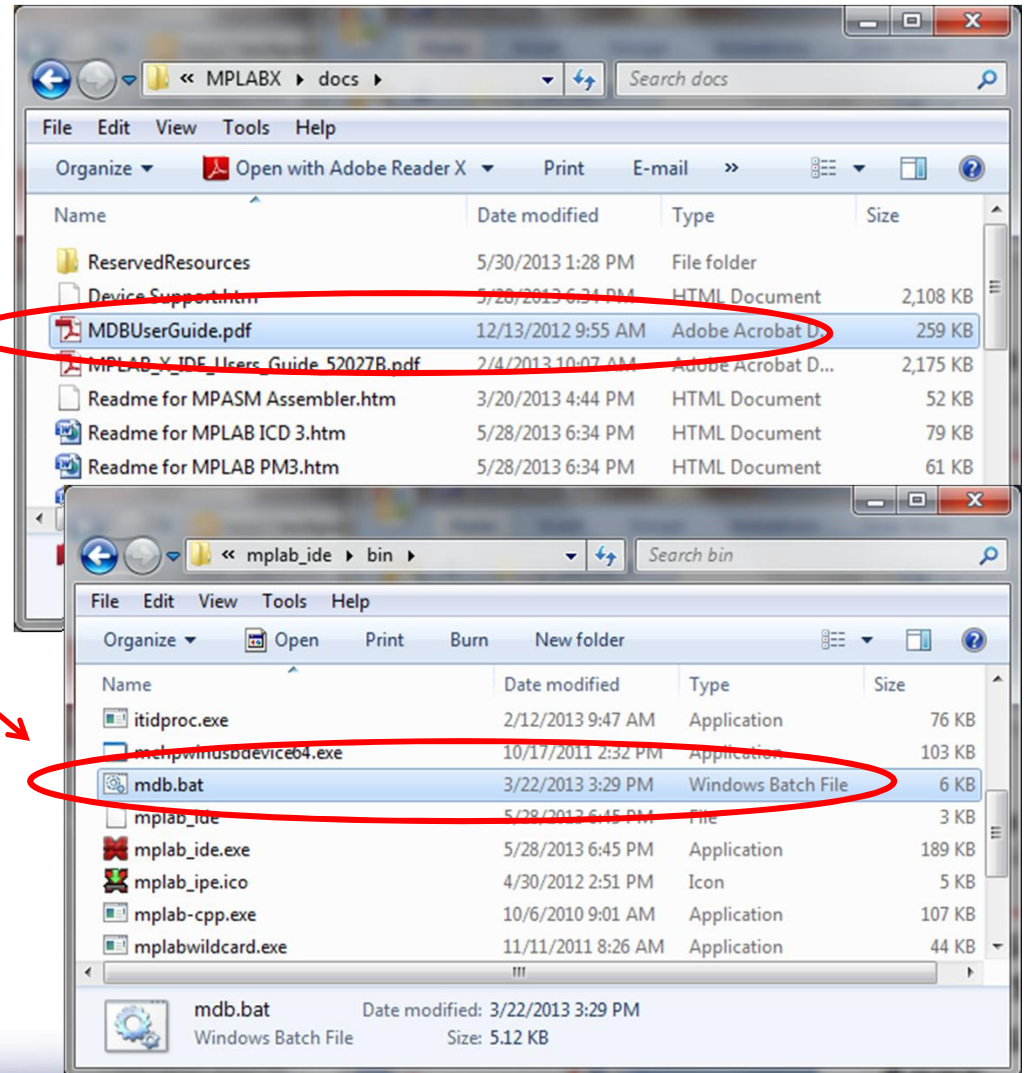
- 1) Косвенное использование через MDV command line
- 2) Прямое управление через MDVScript scripting class
- 3) Использование MDVCore для тестов



Подробности в классе
19012 AMT (создание
плагинов,
SDK,
MDBCs,...)



- Поставляется с MPLAB X IDE
- Руководство → \docs
- Запуск: \bin
- Командный файл для автоматизации



```
>-help
```

The list of classes of commands:

breakpoints -- Making program stop at certain points

data -- Examining/Changing data

deviceandtool -- Selecting debug tool and device

others -- Others

programming -- Programming device and its relative functions

running -- Running the program

stack -- Examining stack

Type "help" followed by a class name for a list of commands in that class.

Type "help" followed by command name for full documentation.

```
>-help deviceandtool
```

List of commands:

Device -- Device devicename

Set the name of a target device.

Hwtool -- Hwtool toolname [-p]

Set the debug tool. Following are the supported tool names.

ICD3.

RealICE.

PICKit3.

SIM.

PM3.

LicensedDebugger.

LicensedProgrammer.

Use the -p option to connect to the tool for programming only.

```
>_
```



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*

Device PIC32MX795F512L
Hwtool REALICE

Program
"C:\32bit.X\dist\default\debug\32bit.X.debug.elf"

Reset MCLR

Sleep 1500

set breakpoint at 0x108

Break C:\32bit.X\src\BasicTest_X_32.c:225

Run

Wait 6000

Print iVar

Quit

Command used –

X:\mplab_ide\bin> mdb.bat mdb_command.txt

```
Administrator: Windows Command Processor
*****
Connecting to MPLAB REAL ICE...
Currently loaded firmware on REAL ICE
Firmware Suite Version.....01.37.11
Firmware type.....PIC32MX
Target voltage detected
Target device PIC32MX795F512L found.
Device ID Revision = 0x4300053
Program "C:\32bit.X\dist\default\debug\32bit.X.debug.elf"
Programming target...
The following memory area(s) will be programmed:
program memory: start address = 0x0, end address = 0x7ff
boot config memory
configuration memory
Device Erased...
Programming...
Programming/Verify complete
Program succeeded.
Reset MCLR
Resetting...
Target reset
Sleep 1500
Break C:\32bit.X\src\BasicTest_X_32.c:225
Breakpoint 0 at file C:\32bit.X\src\BasicTest_X_32.c, line 225.
Run
Running
Wait 6000
Target Halted
Stop at
    address:0x9d0002d4
    file:c:/32bit.x/src/basictest_x_32.c
    source line:225
>
Print iVar
iVar=
0x00000007
Quit
Stop at
    address:0x9d0002d4
    file:c:/32bit.x/src/basictest_x_32.c
    source line:225
>
X:\mplab_ide\bin> mdb.bat mdb_command.txt
```

MDB Core Scripting *

- | **MDBCs (Microchip Debug Core Scripting)** предоставляет примеры использования классов для быстрого старта (MDBC.jar)
 - | Можно использовать в своей группе тестировщиков
 - | Устанавливается вместе с IDE
 - | MDBC classes могут использоваться языками: Groovy, Jython, JRuby, и др.
 - | Создание своих программ в Swing/JavaFX

- | **Доступен SDK для каждого релиза**
www.opensource4pic.org
 - | Документация и примеры работы с классами предоставляемыми MDBCore

MDBCore Scripting

- Как запрограммировать с помощью MPLAB® REAL ICE™ на языке Jython:

```
import com.microchip.mdbcs.Debugger as D
d=D("PIC32MX360F512L", "REALICE")
d.connect()
d.program("/home/jose/t.elf")
```

- Для создания своих специфических приложений



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Сторонние средства отладки

Third-Party Premier Partners



*Over 200 Partners
Worldwide*

And over 1,400 **Design Partners**



Third-Party Tools Directory



www.microchip.com/thirdpartytools

*Third-Party Tools Directory

- Books and Courseware
- Cables
- chipKIT Embedded Platform
- **Compilers**
- Design Services
- Development Boards
- Emulators / Debuggers
- Gang Programmers
- Hardware Tools
- Licensed Manufacturers
- Maker / Hacker Spaces
- Multimedia Boards
- Network Software
- Programmers
- RTOS
- Software Stacks
- Software Tools
- Training Tools

Premier Third-Party Partners

CCS, Inc.



<http://www.ccsinfo.com>
Waukesha, Wisconsin, United States of America
Phone: (262) 522-6500
Fax: (262) 522-6504

Established in 1996, CCS is a leading worldwide supplier of embedded software, and hardware development tools, that enable companies to develop premium products based on Microchip PIC® MCU and dsPIC® DSC devices. CCS C Compilers are the most advanced, highly developed and most widely used compiler in the industry. These compilers include a generous library of built-in functions, pre-processor commands, and ready-to-run example programs to quickly jump-start any project. CCS IDE C compiler products provide a unique Profiler Tool to track time and usage information for use on functions, code blocks, as well as receiving live data from running programs. Complete proven tool chains include a full line of programmers and debuggers, application specific hardware prototyping boards, and software development kits. CCS is also a leading provider of electronic engineering services for embedded software development, R&D support, hardware design, and custom electronic products that adhere to our client's high-quality standards. Download our free demo for the Microchip PIC®MCU C compiler!

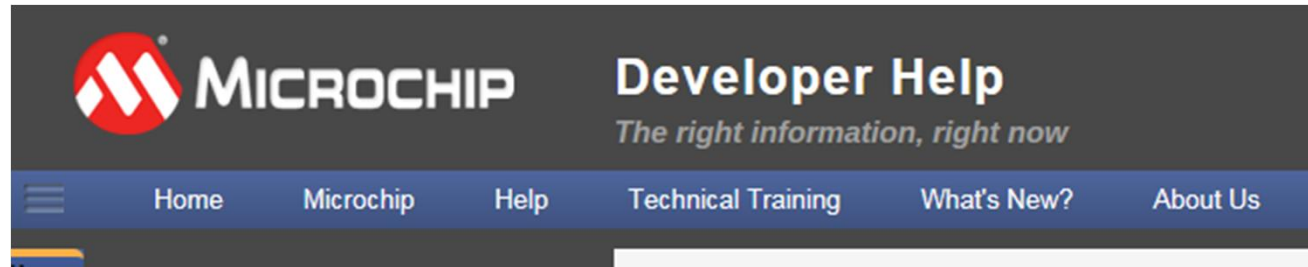
For Technical Support, please visit www.ccsinfo.com/support, contact support@ccsinfo.com, or call 262-522-6500 ext 72. For FAE Support visit www.ccsinfo.com/fae.

Products

- ▶ PCH - CCS C Command-line Compiler for PIC18 Family of PIC MCUs
- ▶ PCM - CCS C Command-line Compiler for Midrange Family of PIC MCUs
- ▶ PCWH CCS C IDE Compiler for Baseline, Midrange, and PIC18 Families of PIC MCUs


Developer Help

microchip.wikidot.com



DEVELOPMENT TOOLS

- Software Tools
 - [Get Started Here](#)
 - MPLAB® X IDE
 - Arriba IDE 
 - [Get Started Here](#)
 - Introduction to Arriba
 - Installation of Arriba
 - A Simple Example Project
 - Shortcut Keys and Icons
 - About Arriba Documentation
 - Viosoft Information

- Hardware Tools
 - [Get Started Here](#)
 - MPLAB Real ICE
 - Emulation Headers & Emulation Extension Paks
 - MPLAB ICD 3
 - MPLAB PICKit 3
 - SEGGER J-Link 
 - [Get Started Here](#)
 - Introduction to the J-Link Debug Probe
 - Introduction to JTAG
 - JTAG and the PIC32
 - USB Drivers and Utilities
 - MPLAB X Plugin for J-Link
 - J-Link Microchip Adapter
 - JTAG Communication Method
 - Manual Memory Selection

LDRA Rules

| LDRA

- | Эксперты в Functional Safety / Software Certification
- | Занимает 5 из 8 мест в MISRA комитете
- | Предоставляют ПО для тестирования кода



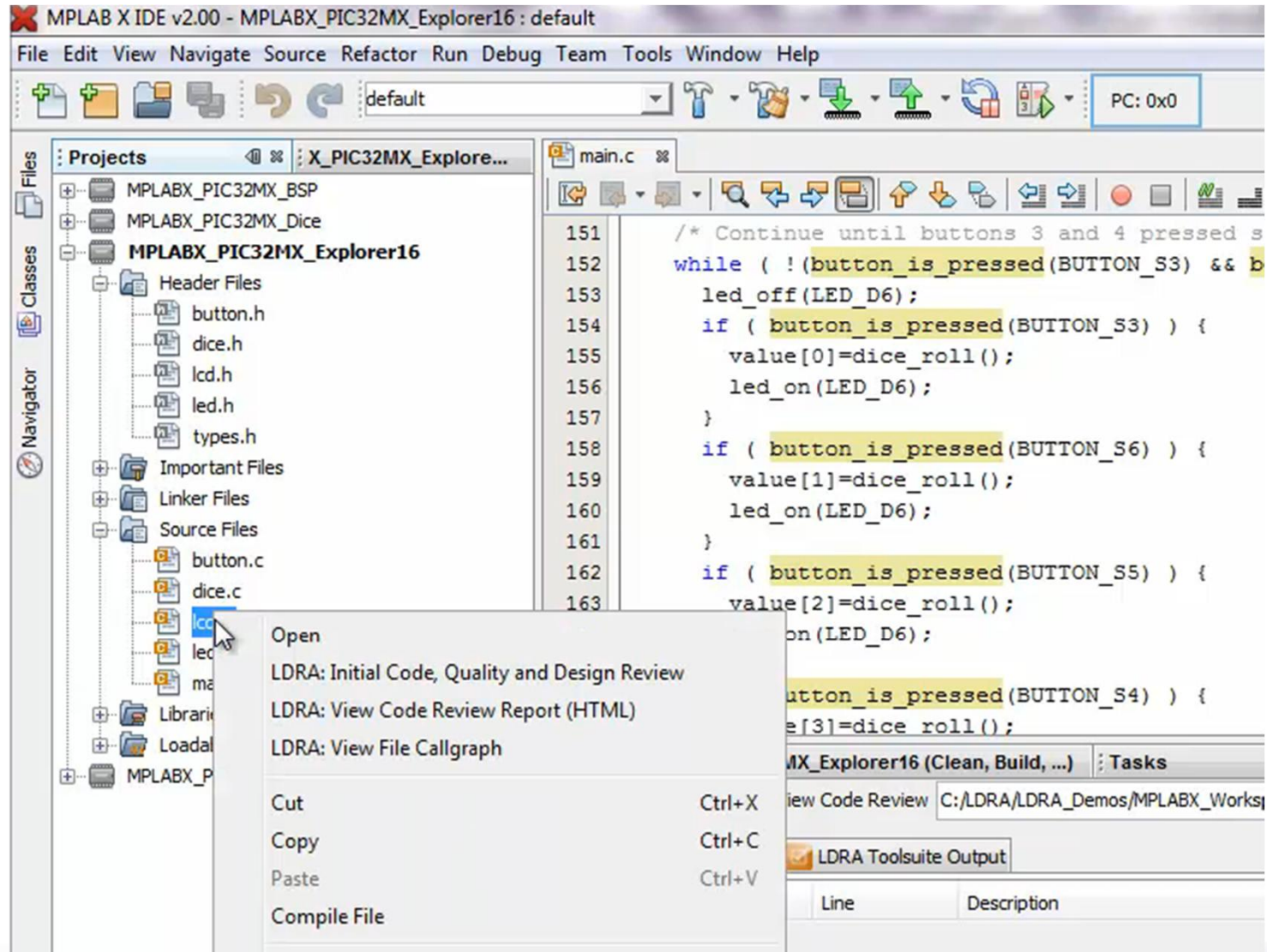
| LDRA Rules для MPLAB[®] X IDE

- | Интеграция в MPLAB X IDE
- | Выполняет статический анализ исходного кода
- | Поддержка 16 промышленных стандартов
- | Конфигурируемость (позволяет задавать собственные правила)
- | Формирует отчеты для аудита выполнения стандартов

Part#: SW500320



LDRA Rules for MPLAB® X IDE

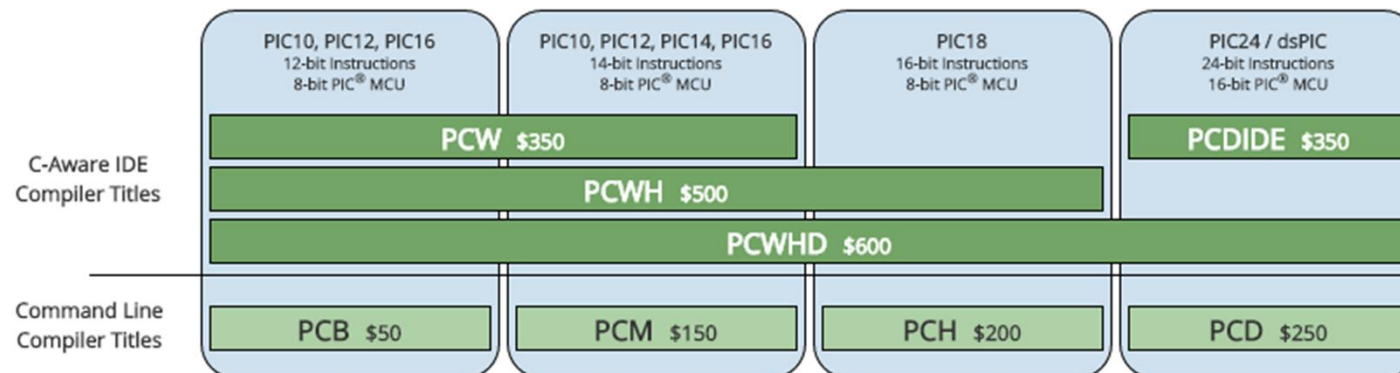


The screenshot shows the MPLAB X IDE interface. The title bar reads "MPLAB X IDE v2.00 - MPLABX_PIC32MX_Explorer16 : default". The menu bar includes File, Edit, View, Navigate, Source, Refactor, Run, Debug, Team, Tools, Window, and Help. The toolbar contains various icons for file operations and development. The left sidebar shows a project tree for "MPLABX_PIC32MX_Explorer16" with folders for Header Files, Important Files, Linker Files, Source Files, and Libraries. A context menu is open over the "Source Files" folder, listing options like "Open", "LDRA: Initial Code, Quality and Design Review", "LDRA: View Code Review Report (HTML)", "LDRA: View File Callgraph", "Cut", "Copy", "Paste", and "Compile File". The main editor window shows C code in "main.c" with line numbers 151-163. The code includes a while loop and several if statements. The bottom right shows a "Tasks" window with "LDRA Toolsuite Output" selected.

CCS Compilers

- | Популярный компилятор для 8-bit, 16-bit МК
- | Command-line, или полнофункциональная среда
- | **Отличительные возможности:**
 - | EZ App Lynx Bluetooth Library (**class 19072 – IoT11**)
 - | Си профилировщик, метрики сложности кода
 - | Тип Битовых данных

C Compiler Solution Suite



www.microchip.com/ccs

MikroElektronika Compilers

- | Компиляторы для 8, 16, 32-bit МК
- | C, Basic и Pascal
- | **Отличительные особенности:**
 - | более 500 библиотечных функций
 - | Исходники примеров на LibStock.com
 - | Аппаратный ключ лицензий

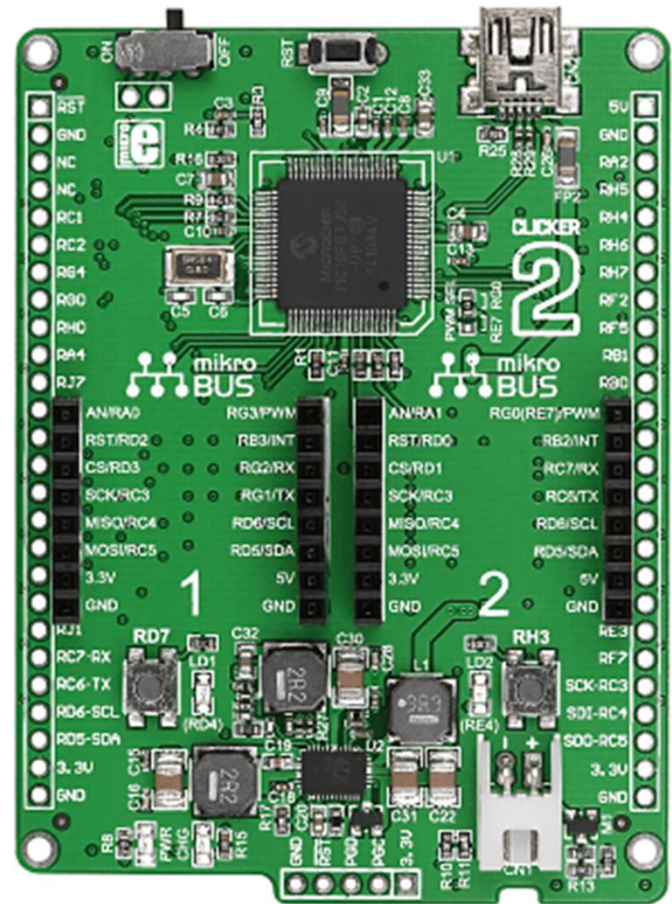


www.microchip.com/mikroe

Clicker 2 for PIC18FJ

- Производитель: MikroElektronika
- PIC18F87J50 MCU
- 128K Flash, 3.8K RAM
- Два сокета mikroBUS™
(Более чем 100 “Click” плат)
- Встроенный USB-HID bootloader
- LiPo зарядник

Part#: TMIK031



Click Boards by MikroE



**ADC Click
TMIK024**



**GPS Click
TMIK028**



**DigiPot Click
TMIK025**



**DAC Click
TMIK026**



**GSM Click
TMIK027**



**Relay Click
TMIK029**

- | **Производитель: Digilent**
- | **PIC32MX695F512L w/ 512K Flash, 128K SRAM**
- | **Microchip MRF24WG0MA Wi-Fi® module**
- | **Micro SD card connector**
- | **USB 2.0 OTG controller with A and micro-AB connectors**
- | **43 available I/O pins**
- | **12 analog inputs**
- | **80 MHz operating frequency**

Part#: TDGL021



Komodo CAN Duo Interface

- | **Производитель: Total Phase**
- | **Контроль 2-х CAN каналов**
- | **Запись, Редактирование, Воспроизведение последовательностей команд**
- | **8 линий порта V\B**
- | **USB 2.0 full-speed**
- | **Бесплатное ПО и API**
- | **Windows, Linux, Mac OS X**



Part # TTP100008

ICP2PORT Programmiers

- | **Производитель: Softlog**
- | **Portable, rugged design for field service upgrades**
- | **Programmable clock/data speed**
- | **4 MB flash, 6 environments**
- | **Secure option available**



Part #TPG100009 (8-bit)

Part #TPG100010 (8,16)

Part #TPG100011 (8,16,32)

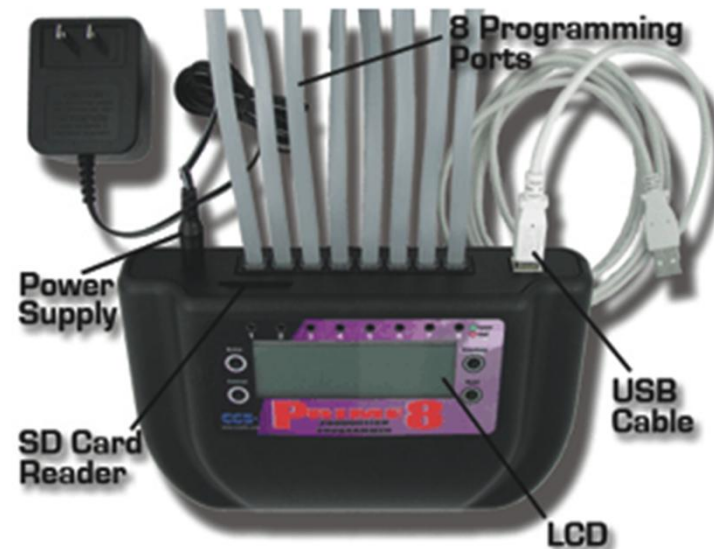
Desktop and Gang models also available

Prime 8 Gang Programmer



- | **Производитель: CCS**
- | **Program up to 8 targets at once**
- | **SD card reader, stand-alone operation**
- | **Supports 2V to 5V targets, 8-bit and 16-bit**
- | **Windows, Linux compatible**

Part #TPGPRM8





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chipKIT™ Platform*

chipKIT™ Development Platform*

- | **Open-source, inspired by Arduino™**
- | **Powered by Microchip 32-bit MCUs**
- | **For beginners: easy to learn**
- | **For experienced engineers: quick to prototype**
- | **Many options available**
 - | Development boards in standard Arduino format
 - | Custom boards, Industrial Controllers
 - | Single-chip w/ bootloader

chipKIT™
EMBEDDED PLATFORMS

chipKIT™ Development Platform*

- | **High-performance processors (up to 200 MHz)**
- | **Large memory (up to 2048K Flash, 512K RAM)**
- | **Supported by multiple IDEs**
 - | Including MPLAB X, v3.05 or later
- | **Perfect for engineers migrating to PIC32**

- | **More Info:**
 - | **19005 ARD (chipKIT Introduction)**
 - | **19070 IoT8 (Cloud Computing)**
 - | **chipKIT.net**



Third-Party Tools Summary

- | **200+ партнеров**

See <http://www.microchip.com/thirdparty>

- | **Сотни отладочных средств**

Для всех стадий разработки

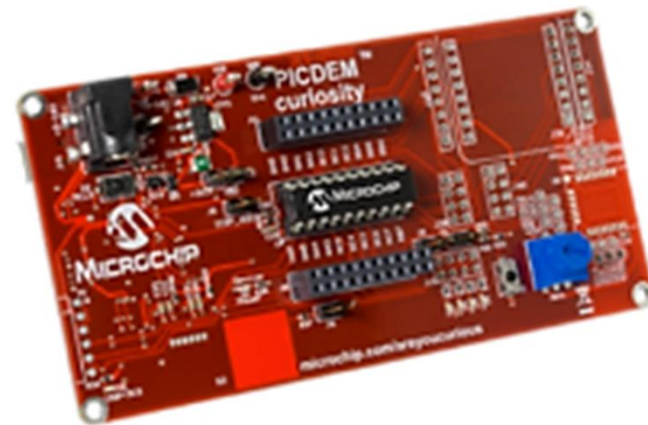


MICROCHIP

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Новые отладочные платы

- **Поддержка:**
 - 20, 14, 8- выводных МК
 - Поставляется с PIC16F1619
 - Программатор/отладчик интегрирован в плату
 - Светодиоды для индикации
 - mTouch[®] сенсорная кнопка
 - Кнопка
 - Потенциометр
 - Посадочное место для RN-4020 Bluetooth и разъем mikroBUS[™]

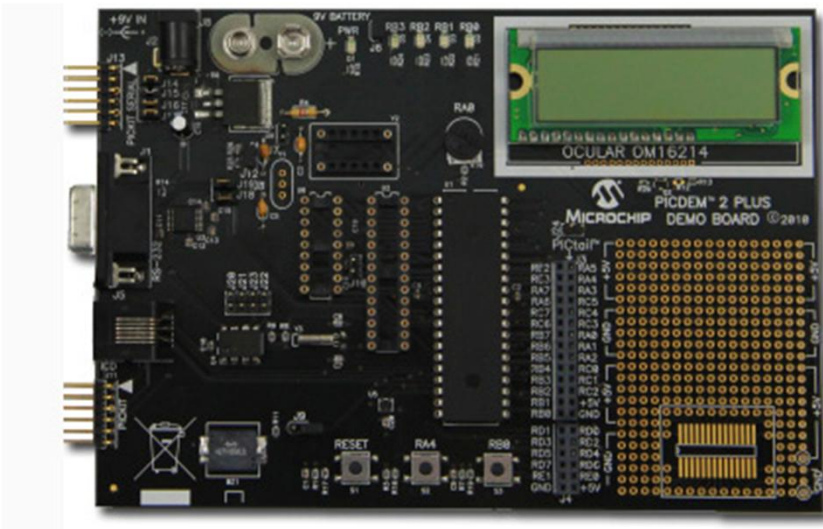


Part Number: DM164137

PICDEM™ 2 Plus

- **Comprehensive development and learning platform:**

- LCD display
- Piezo buzzer
- Temperature Sensor
- 4x LEDs
- Microchip TC74 thermal sensor
- 32K x 8 Serial EEPROM
- 5 kΩ pot for devices with analog inputs
- On-board external oscillators
- Three pushbutton switches for external stimulus and reset
- Works off of a 9v battery or DC powerpack



Part Number: DM163022-1

Explorer 8



Part Number: DM160228

- | **Rapid proof of concept platform**
 - | Supports 6,8,14,20,28,40 pin DIPs
 - | PIM module for higher pin counts
 - | 2x Mikrobus headers
 - | 2x PMOD headers

PIC24F Starter Kit for Intelligent Analog



Part Number: DM240015

- | Analog Header
 - | Clean Analog Signals
 - | Plugs Into Breadboards
- | Audio
 - | Mic & Headphones
- | On Board Sensors
 - | Light & Temperature
- | Rich Display
 - | Scrolling Banner
 - | Custom Icons
 - | mTouch[®] sensing solution Controls
- | Connectivity
 - | USB OTG, Host & Device
 - | RF Module Footprint
- | Integrated Debugger

dsPIC33EV 5V CAN-LIN Starter Kit



MPLAB[®]
CERTIFIED

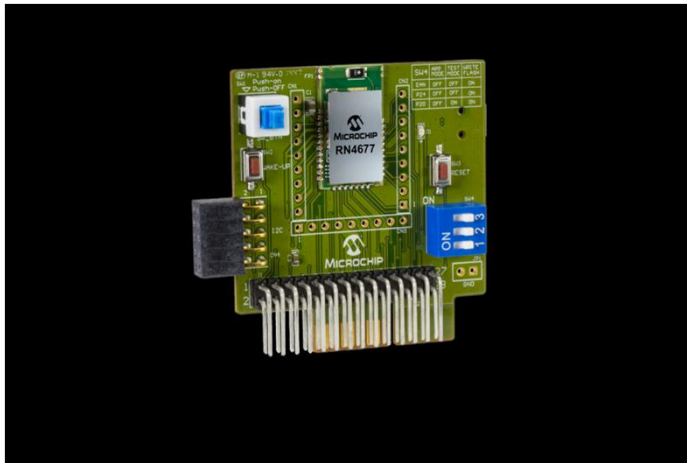
- | Features dsPIC33EV256GM106 with CAN, LIN and SENT
- | CAN/LIN transceivers on board
- | Demo transmits messages from all 3 serial interfaces
- | 5V operation for robustness in high-noise environments
- | Push buttons, LEDs, temp sensor, potentiometer
- | Integrated programmer and debugger
- | USB Powered
- | Breakout connector for unused I/O

Part Number: DM330018



dsPIC33EV 5V CAN-LIN Starter Kit
(Part # DM330018)

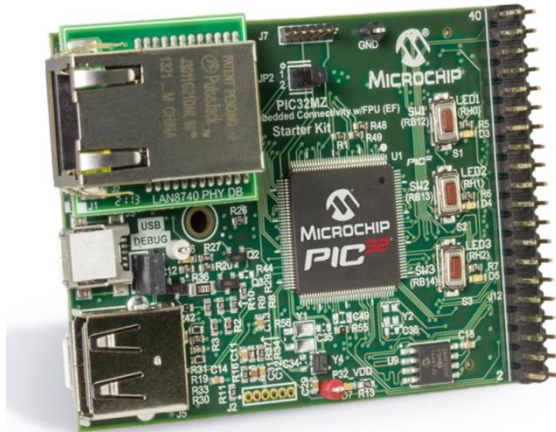
RN4677 Bluetooth® 4.0 Dual Mode PICtail™/PICtail Plus Daughter Board



Part Number: RN-4677-PICTAIL

- | Enables rapid development with the **RN4677** Dual Mode Module
- | PICtail and PICtail Plus interfaces
 - | Connection to
 - | Microchip Explorer 16 (DM240001)
 - | PIC32 I/O Expansion board (DM320002)
 - | PIC18 Explorer (DM183032) development boards
 - | Configuration Library for PIC18, PIC24F and PIC32
 - | **Enables easy integration**
 - | On-board connection and data status LEDs
 - | On-board USB to UART bridge
 - | **Easy development from PC**

PIC32MZEF with Floating Point Unit



**Part Number: DM320007 &
DM32007-C (Crypto Engine)**

- | **PIC32MZEF MCU (200MHZ, 2MB Flash, 512KB DRAM).**
- | **12 bit ADC @12MSPS.**
- | **Floating Point Unit @200 MFlops for fast single and double-precision Math**
- | **Integrated debugger/programmer**
- | **USB Powered**
- | **10/100 Ethernet Development using PIC32 MCUs**
- | **Hi-Speed USB Host, Device, Dual Role and OTG**
- | **4 MB SQI Flash, 2 CAN 2.0b, 6 UART/SPI/I2S, 5 I2C**
- | **Online tools & software download**
- | **Enables addition of PIC32 Expansion Board, for connecting application-specific daughter boards**
- | **High resolution Audio Support**

PIC32MZEF (Plug-In Modules)



**PIC32MZ2048EF Explorer 16 Plug-In Module
(Part # MA320019)**

- PIC32MZEZ Processor Plug-In Module (PIM)
- PIM plugs into Explorer 16 Board
- Explorer 16 is a low-cost, modular development board for Microchip's 16-bit PIC24, dsPIC[®] DSC, and the 32-bit PIC32 microcontroller families



**PIC32MZ2048EF 144-pin Plug-In Module
for Bluetooth[®] Audio Development Kit
(Part # MA320018)**

- PIC32MZ Processor Plug-In Module (PIM)
- PIM not compatible with Explorer 16 Board
- Enables Bluetooth and Digital Audio development with PIC32 Bluetooth Audio Development Kit.
- Hi-Speed USB Device/Host/OTG support , SPI/I2S and UART

Ask Us Questions



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