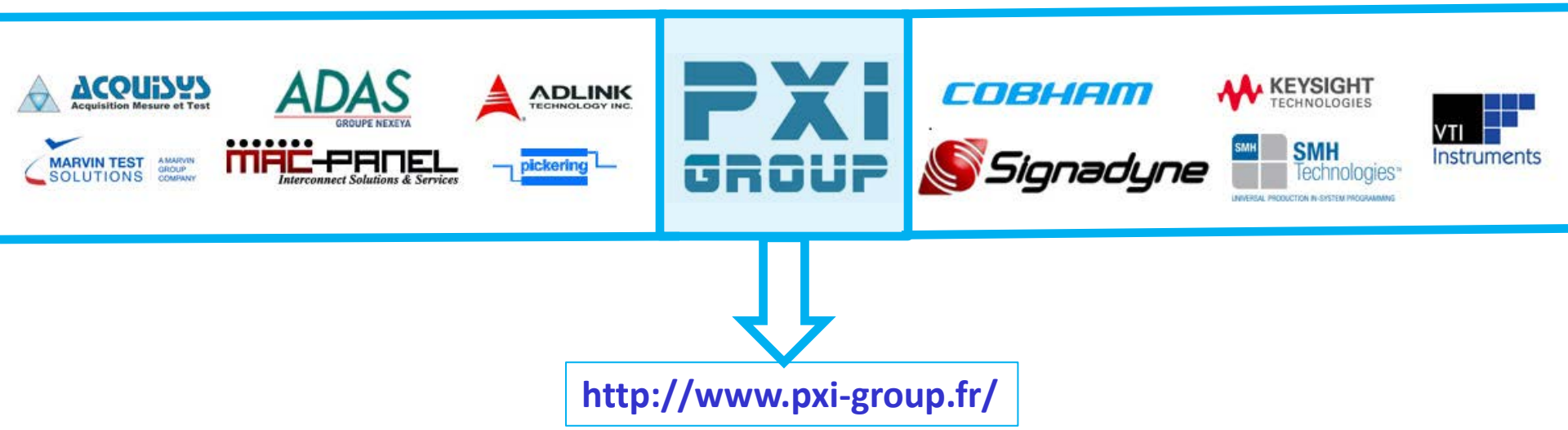
PXI GROUP

A tradition of excellence

Innovative PXI hardware, software, & test solutions
for military, aerospace and manufacturing

JOURNEE TECHNIQUE PXI – 15 AVRIL

L'association **PXI-Group** a été constituée par huit sociétés impliquées de manière importante dans le PXI ou le PXI Express.
Le but du **PXI-Group** est de promouvoir les solutions PXI au travers de conférences techniques , expositions en France et vous tenir informé des dernières innovations et produits



http://www.pxi-group.fr/

Marvin Test Solutions

Titre : **Comment intégrer ces propres fonctions instruments dans un module PXI / FPGA**

La technologie FPGA combinée avec le PXI/PXIe permet aujourd'hui de créer ses propres instruments PXI ou fonctions dans un temps record en utilisant les outils standards du marché.
Cette présentation est un exemple d'implémentation de fonctions utilisateur sur carte PXI à base FPGA Altera et les outils de développement Quartus (Altera TM).

Victor Fernandes

Marvin Test Solutions, Inc.
78760 Jouars Pontchartrain
Tel: +33 6 89 88 50 76
www.MarvinTest.com

The Marvin Group Capabilities

Aircraft Armament Equipment

- Bomb Racks
- Ejector Racks
- Missile Rail Launchers
- Multiple Carriage Systems
- Pylons

Test & Support Systems

- Armament and munition Test Sets
- SMS Test Sets
- Flightline, I-level, and depot-level testers
- Production test equipment

Land Systems

- Mission Critical Equipment Trailers and Shelters
- Vehicle Environmental Systems
- Auxiliary Power Units
- Weapons Stations

Tactical Vehicles

- Light Strike Armored or Unarmored
- Rescue and Personnel Recovery
- Reconnaissance
- Anti-tank

Machining Tooling Prototype

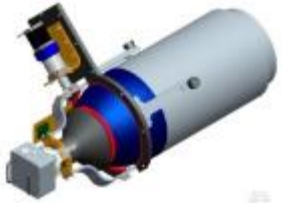
- Armored Personnel Carriers
- MRAP
- Abrams
- Bradley
- FMTV
- JLTV
- Stryker

Total Solutions & Support Capabilities including repair, overhaul, upgrades, maintenance & training

The Marvin Group – Products

Alternate Mission Equipment (AME)

Test Products and Solutions



Land Systems Products

Vertical Integration Delivers Solutions

Supporting our customers with innovative test solutions

Hardware Building Blocks

Software Building Blocks

ATEasy Test Development Studio

DIOEasy

CalEasy™

Preconfigured Systems

Vertical Integration (cont'd)

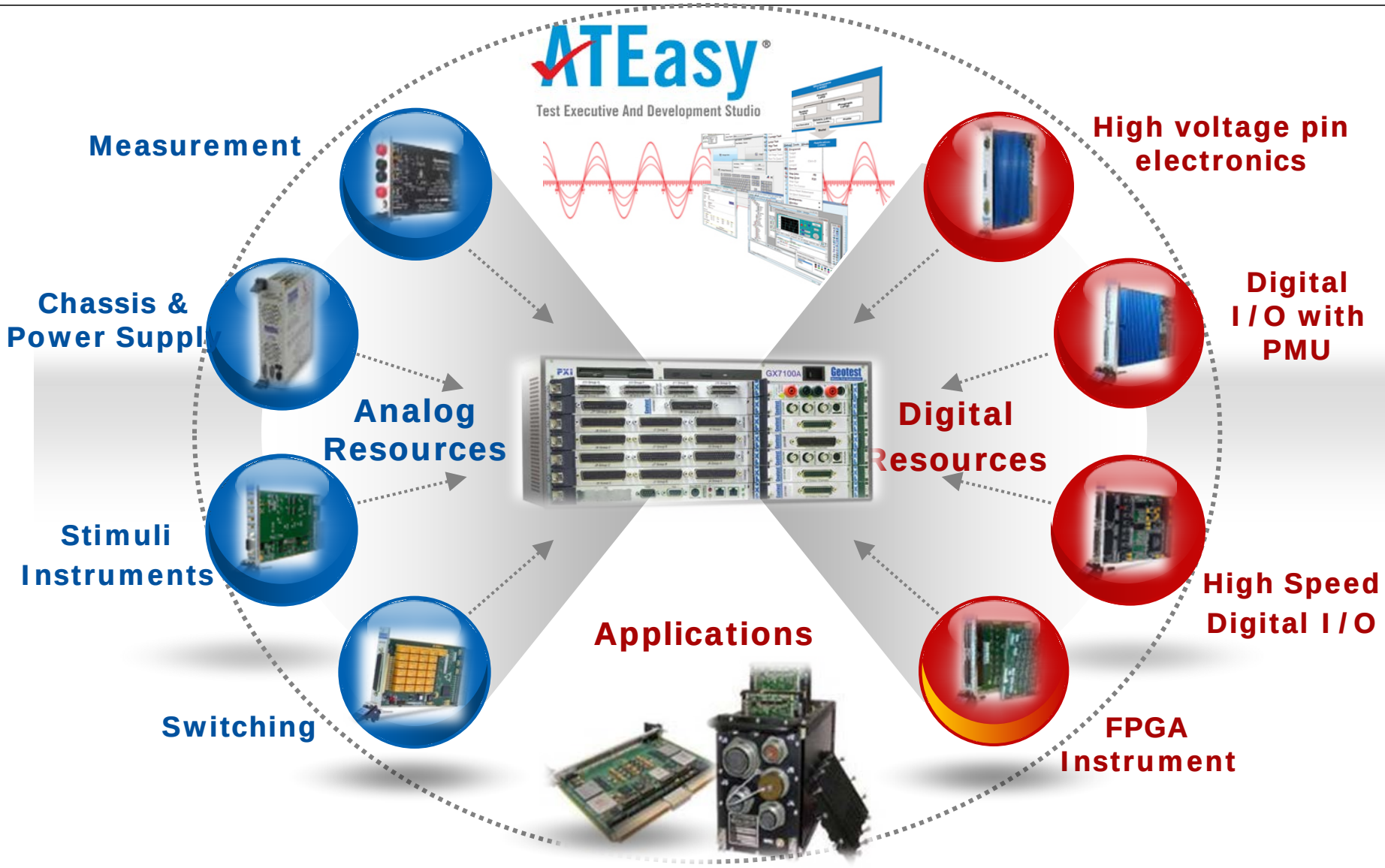
Supporting our customers with innovative Turn-Key test solutions

O-Level (Flight-Line)

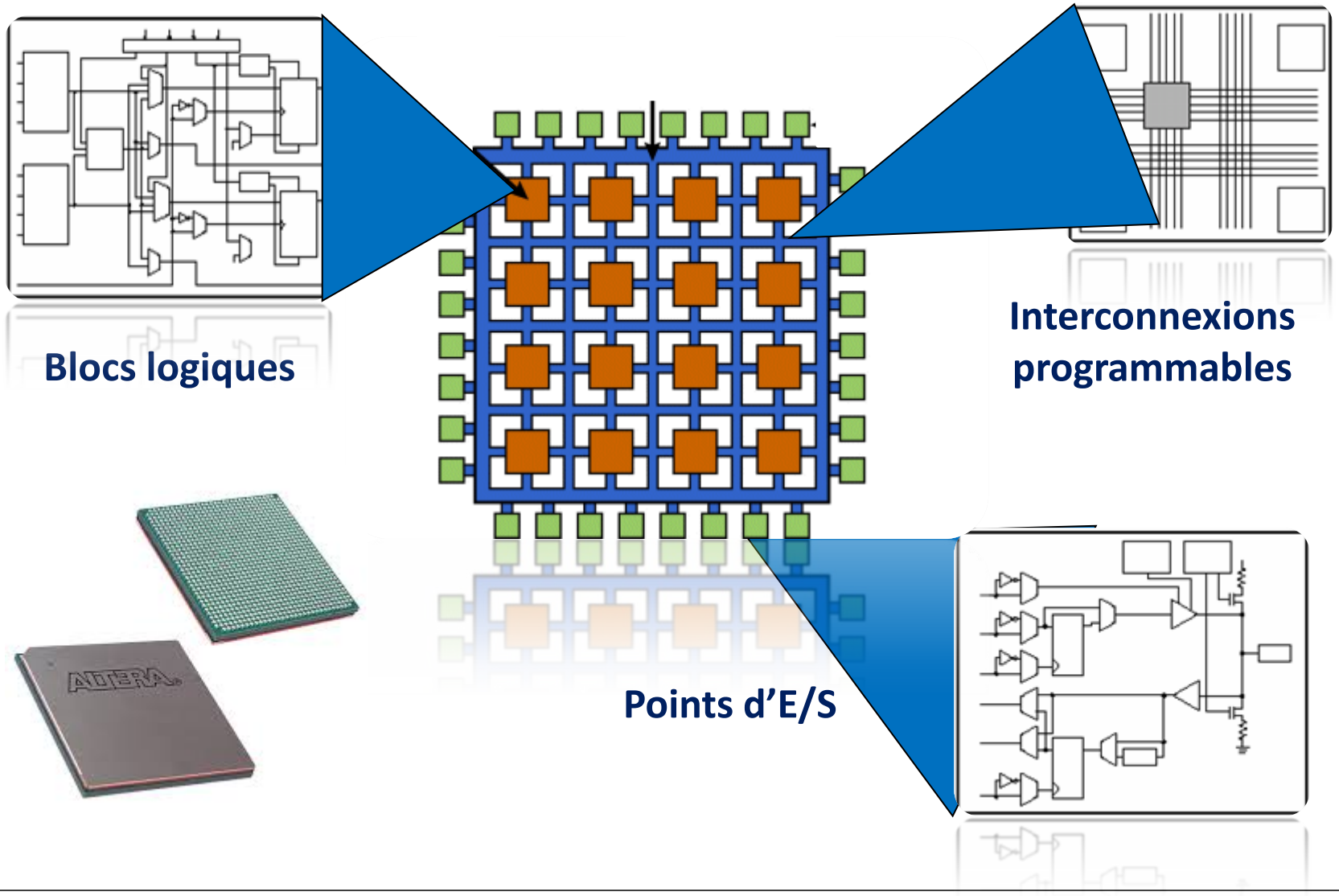
I-Level (Back-Shop)

D-Level (Depot)

MTS - PXI Products overview



Technologie FPGA

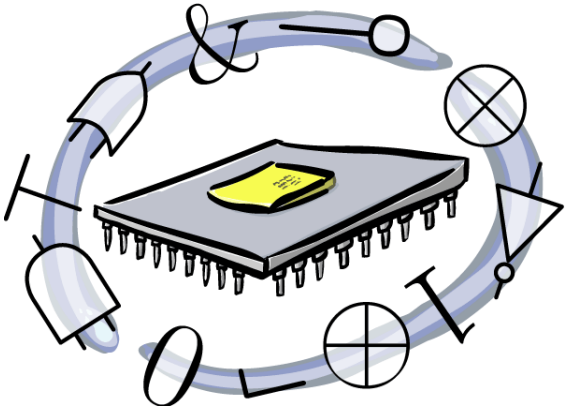


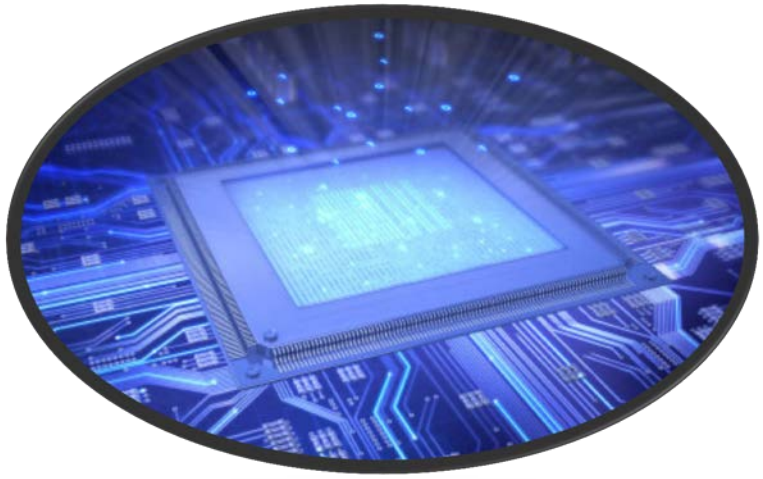
Pourquoi Instrumentation modulaire a base de FPGA ?

- ***Reconfigurables*** : créer une personnalisation spécifique à l'appareil sous test ou à l'application
- ***Faible latence*** : exécuter des algorithmes déterministes < 5 ns
- ***Haute performance*** : les capacités de calculs ouvrent de nouvelles possibilités pour la vitesse de mesure et de traitement de données
- ***Massivement parallèles*** : permet des tâches parallèles et de « pipelining », pour réduire les temps d'essai
- ***Grande fiabilité de fonctionnement*** : l'application est mise en œuvre dans le matériel

Les FPGA dans le domaine des applications d'instrumentation

- Protocoles numériques personnalisés
- Émulation
- Traitement des données
- Acquisition de donnés, déclenchements avancés
- Génération de signaux
- Communication de bus et protocoles
- Simulation
- Cryptage
- Traitement d'images avancé
- Utilisation d'IP externes
- Drivers spécifiques
- Modulation et démodulation personnalisées





FPGA reconfigurable & conditionnement du signal non modulaire

On distingue plusieurs familles de produits COTS , FPGA reconfigurable.

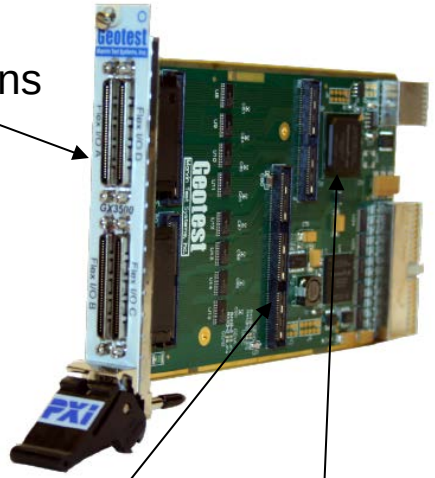
- Instruments modulaires architecture « hardware fixe » et « firmware » modulaire par reconfiguration du FPGA en fonction du besoin
  - GX1120 – Générateur fonctions arbitraires (AWG) reconfigurable en synthétisée (DDS)
  - GX529X – Générateur/analyseur de patterns numériques avec PPMU, reconfigurable testeur Mem's multisite
  - GX3606 – 80 E/S TTL Différentiel TTL, RS-485 compatibles
  - GX3610 - 80 E/S mLVDS 200 Mhz,

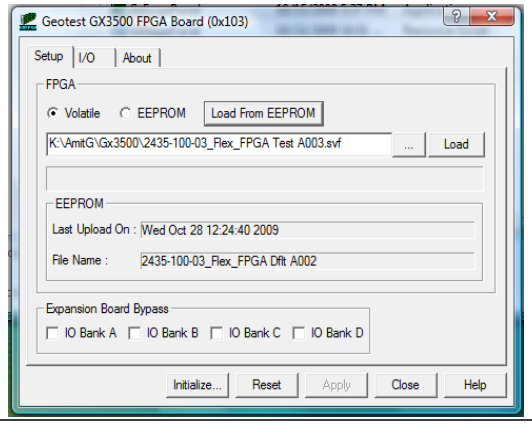
FPGA reconfigurable & conditionnement du signal modulaire

- Instruments modulaires architecture « hardware/firmware » modulaire par reconfiguration du FPGA et changement carte mezzanine en fonction du besoin
  - Solution souple et intégrée aussi bien au niveau logiciel que matériel
  - Souplesse de conditionnement de signaux grâce aux modules internes
  - Emulation de fonctions existantes (obsolescence)
  - Pas de câblage ni de mécanique supplémentaire

Flex DIO – GX3500

- User programmable FPGA, 3U PXI Card for digital and mixed signal applications
- High performance FPGA - 150 MHz clock rate
- 55,856 Logic Elements, Foul PLL's, 2.34 Mb internal memory
- Digital FPGA card with 160 I/Os
  - I/O compatible with the NI 7811R & the 7813R
- Targeted for custom digital interface and custom instrumentation designs

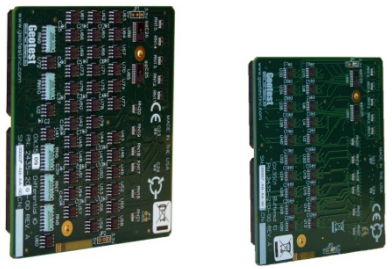




GX3500 FPGA Flex DIO Expansion Boards

- User programmable FPGA 3U PXI Card for digital and mixed signal applications
- Standard expansion boards:
  - 80 channel differential TTL daughter board
    - RS-485 compatible
    - Independent direction control
  - 80 channel LVTTL buffer daughter board
    - Independent direction control
  - 80 channel mLVDS buffer daughter board
    - Independent direction control
  - 40 channel MECL daughter board

✓ Benefit: A single 3U slot solution



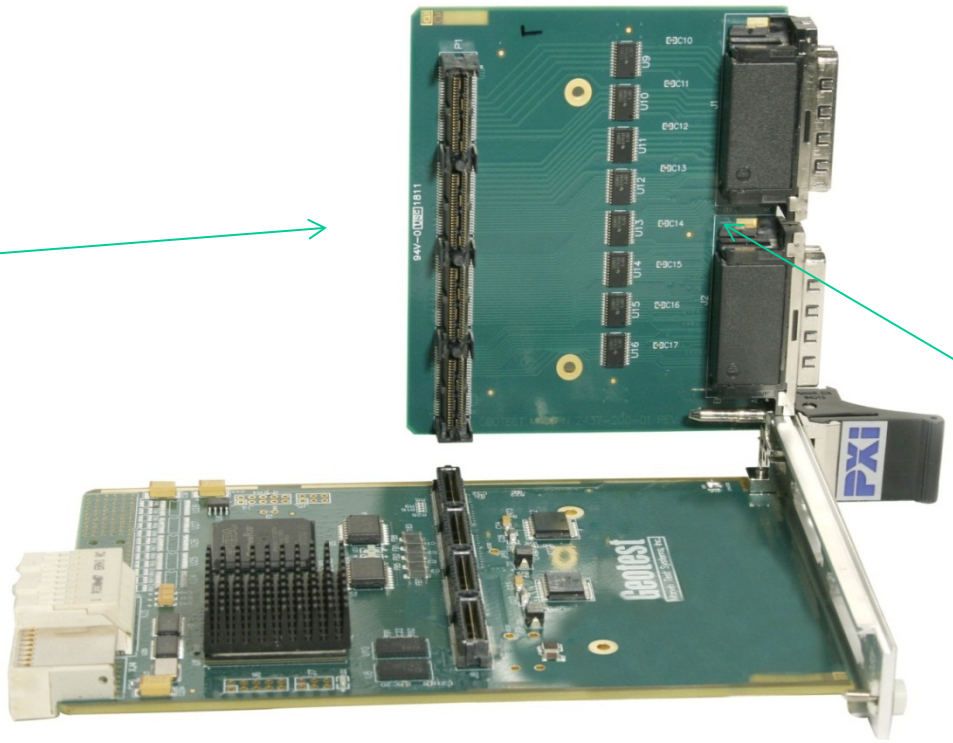
GX3700 & GX3700e – PXI and PXI Express Performance Flex DIO FPGA Boards

- User programmable FPGA 3U PXI and PXI Express Cards for digital and mixed signal applications
- Altera Stratix III FPGA
  - Supports SERDES rates to 1.2GHz
  - I/O rates > 700 MHz

- 160 I/O channels (single ended) & 42 differential
- 47,500 Logic Element, Four PLL's, 256K x 32 on board SSRAM
- No proprietary design tools required - uses free, web-based Altera tools*
- Optional daughter boards with application specific I/O connectors
- PXIe version supports DMA data streaming rates >800 MB/s

GX3700 / GX3700e Architecture

High performance connectors



Expansion board with I/O connectors

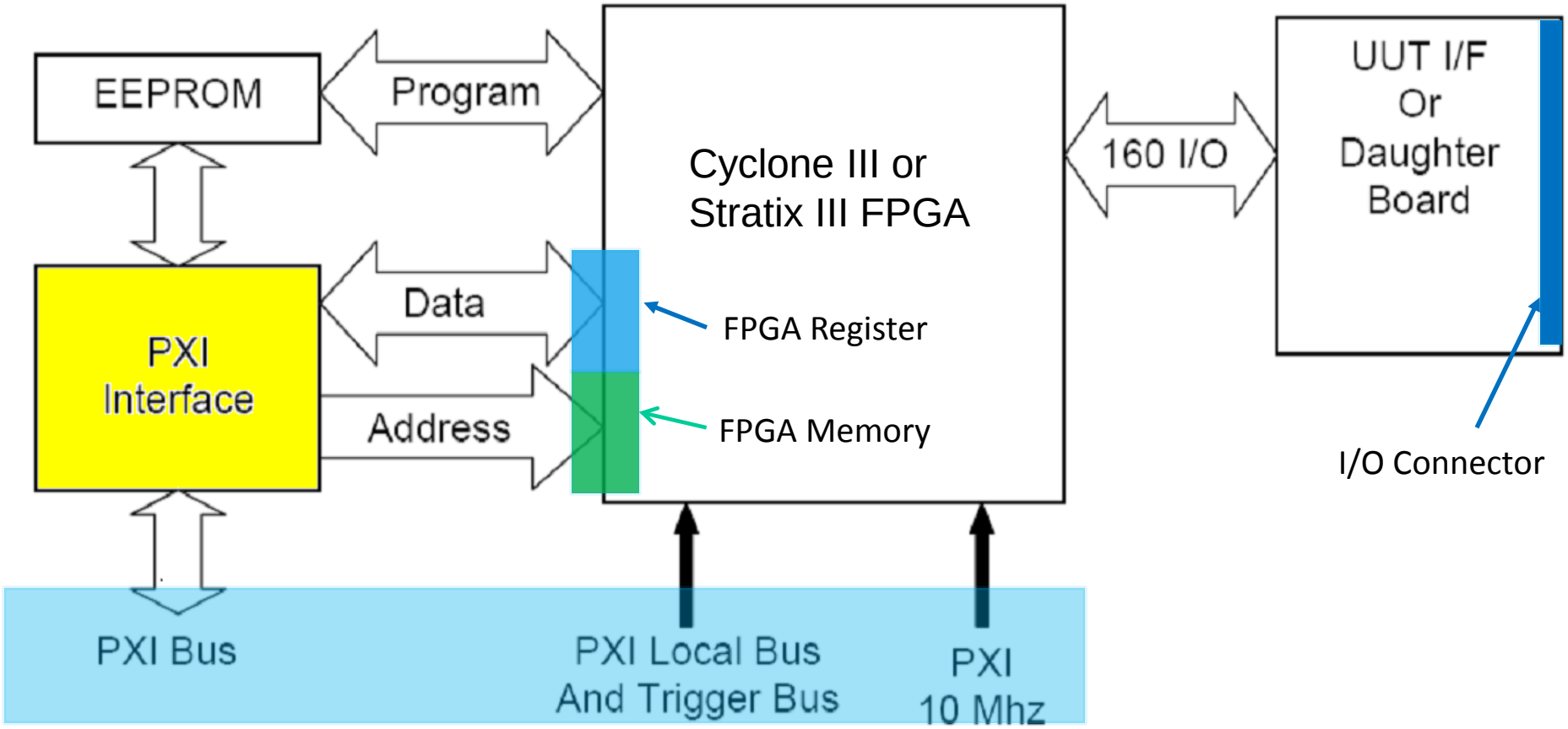
GX3700 and GX3700e cards are supplied with an standard expansion board (shown above)

GX3788: Multifunction FPGA (new)

- Based on the GX3700 FPGA
- Incorporates 8 D/A and A/D channels
- Key A/D specs:
  - 16 bits resolution
  - 250 KS/s sampling
  - 8 DE or 16 SE inputs
  - 5 ranges, up to +/- 10 V
  - Supports DMA
- Key D/A specs:
  - 16 bits resolution
  - 1 MS/s for each channel
  - 8 channels
  - +/- 10 V output
  - Supports streaming

FPGA Flex DIO Block Diagram

- PXI interface is built-in, pre-decoded address space
- The user does not need to design the PXI interface – simplifies the user's design and control



Architecture typique d'un système

Application client

ATEasy Test Executive Autre ..

LabVIEW , Visual Studio, ATEasy

API, VISA, IVI, DLL, ……

Application FPGA

Test Manag. Software

Application

Instr. Drivers

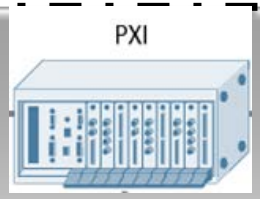
Outils development FPGA

VHDL

Application FPGA #n

Logiciel

Materiel



Chassis PXI

#1,PXI

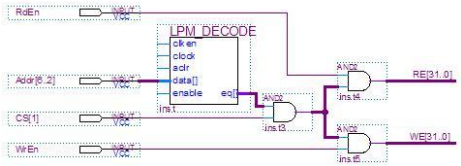
#n, PXI

#n+1, PXI

UST

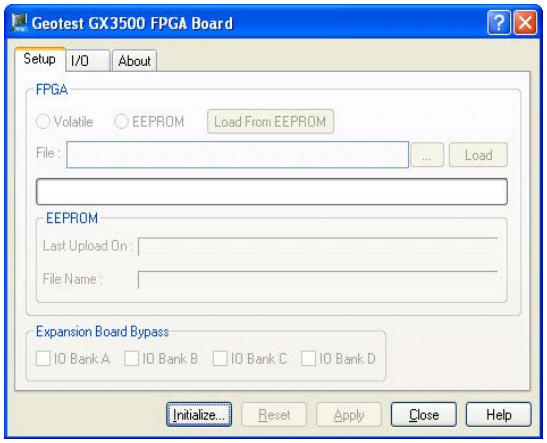
Altera Quartus II Web Edition Software

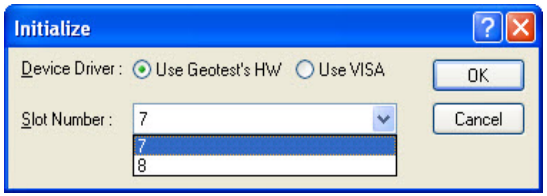
- Use with GX3500 or GX3700* products
- Free download from Altera's web site
  - https://www.altera.com/download/software/quartus-ii-web
- Uses standard design methods, designers do not need to learn a new design paradigm or purchase new design tools
  - Schematic Capture
  - VHDL
- Supports third-party tools
- On-Line training available from Altera

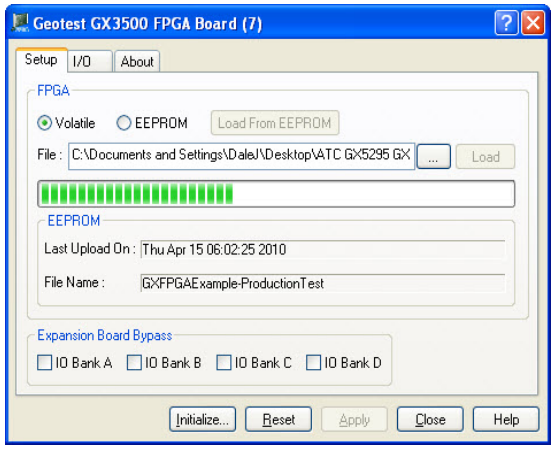


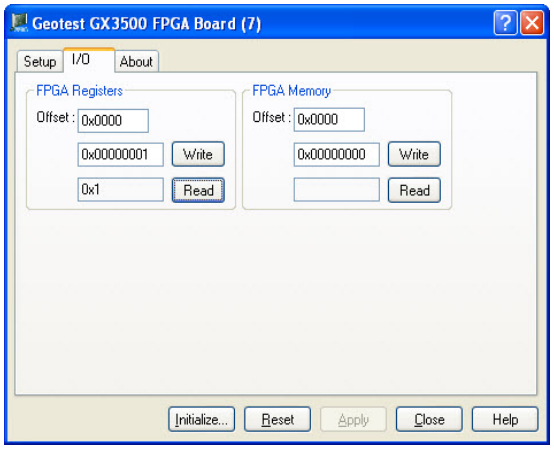
FPGA Flex DIO Software

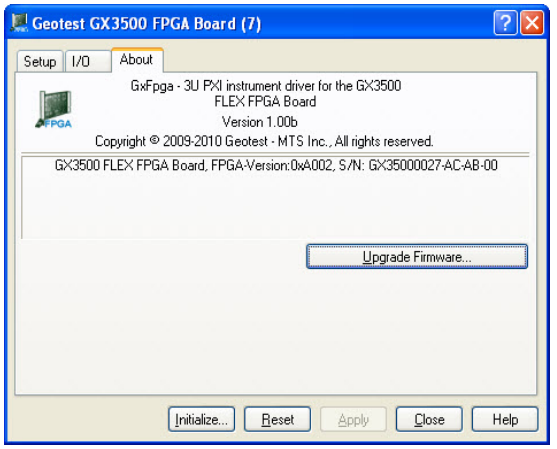
- Interactive UI and API library for loading/control of FPGA
- Load logic to EEPROM or RAM
- Enable / Bypass Expansion Boards
- Read / Write Registers / Embedded RAM
- Full support and access to all PXI resources
- ✓ Support for Windows & Linux



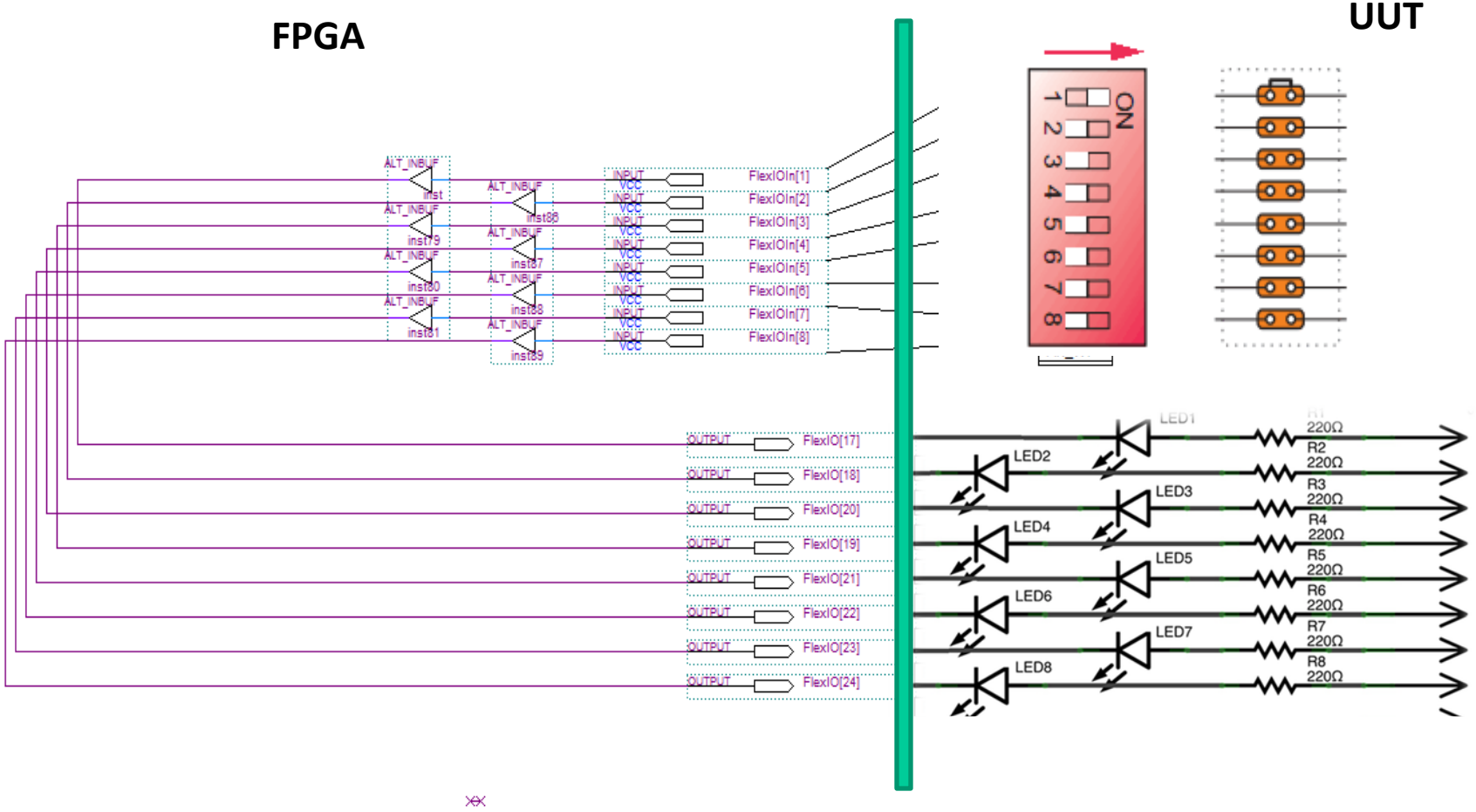




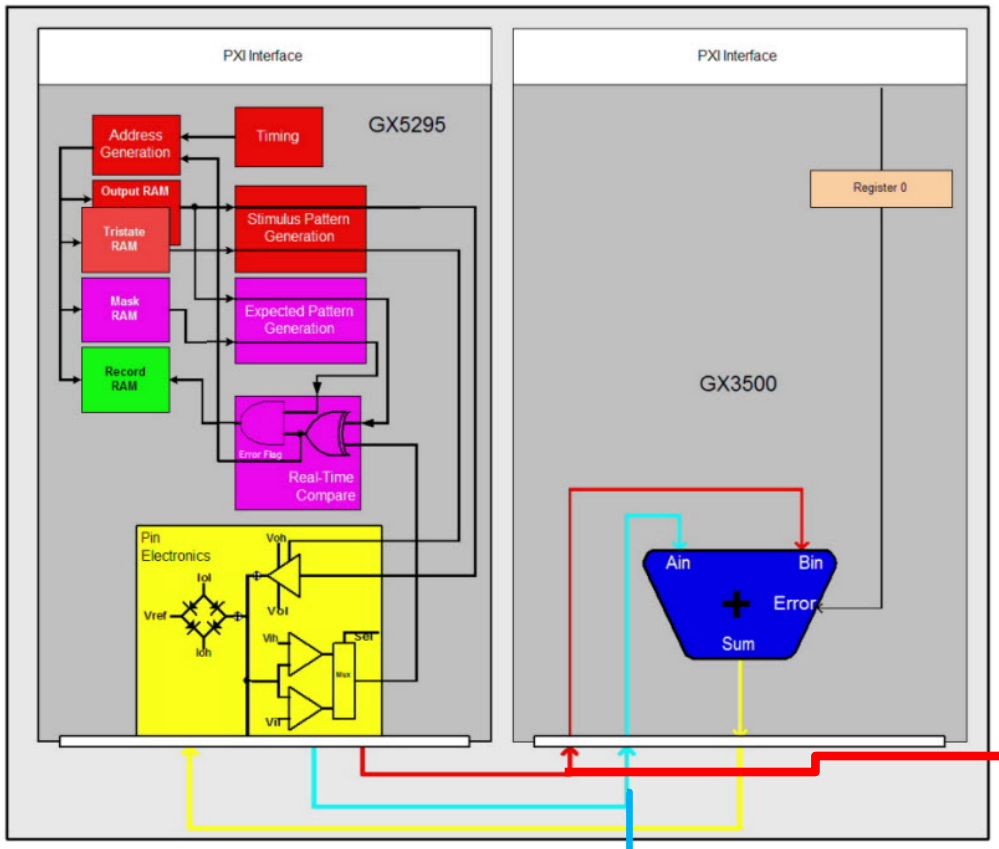


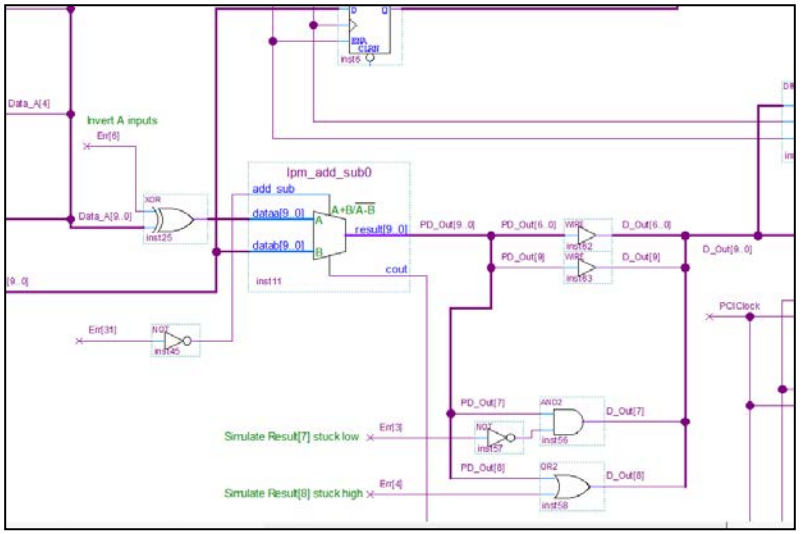


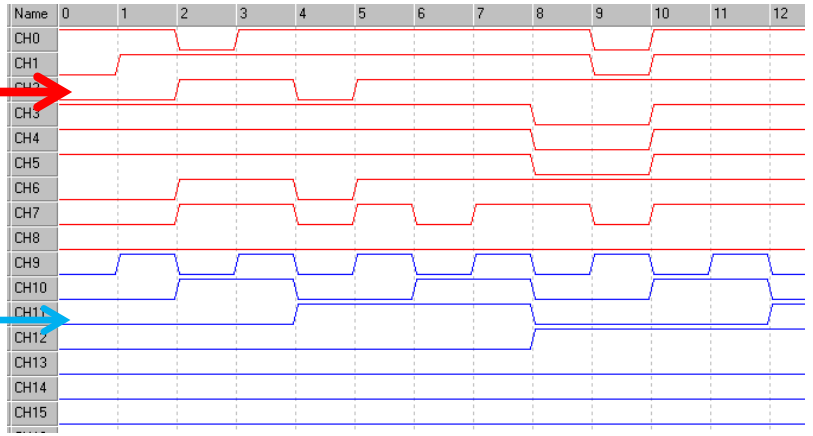
Example static LED & Switch



Flex DIO Design Examples

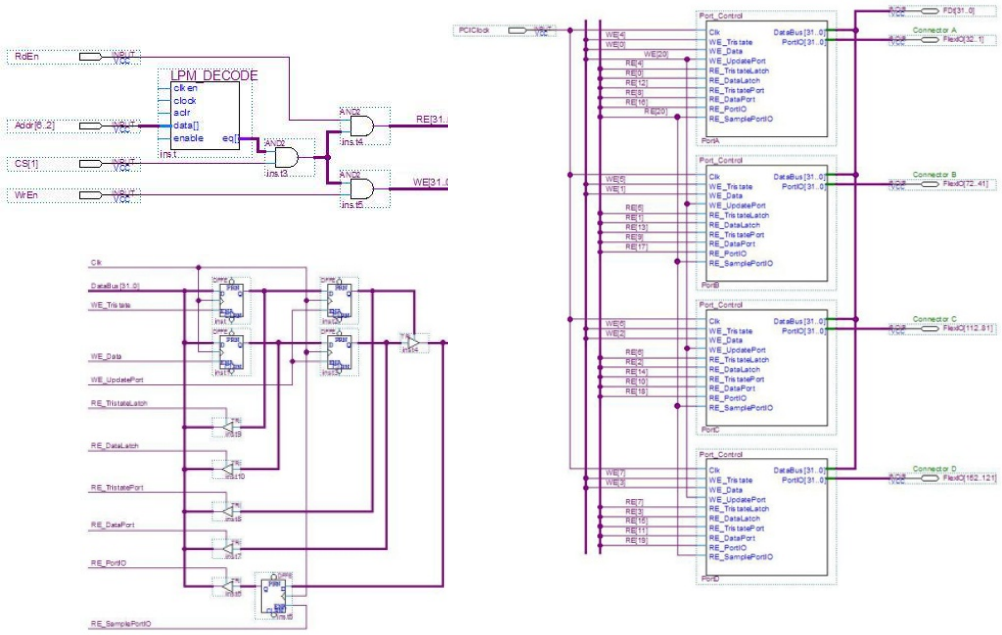






Flex DIO Design Examples

- Knowledge-Base article
  - 128 Channel Static DIO, Schematic Capture
  - Program examples in ATEasy, “C” and LabVIEW
  - http://www.marvintest.com/KnowledgeBase/KBSearchArticles.aspx?ID=205&task=go&search=3500&type=AND



ATEasy Example (using the ATEasy GX3500 Driver)

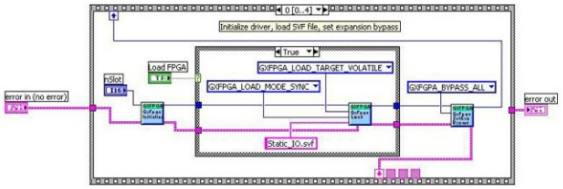
```
dwData:DWord[4] ! Contains output state for 32-bit ports A- D
dwTristate:DWord[4] ! Contains tristate control for 32-bit ports A-D
dwInput:DWord[4] ! Contains data read from four latches A-D
i:Long ! Index counter

Driver Initialize (12) ! Initialize driver for instrument in slot #12
FPGA Load (".\\Static_IO.svf",TARGET_VOLATILE,MODE_SYNC) ! Load SVF file to volatile FPGA memor
FPGA Set ExpansionBoardBypass(0b1111) ! Set the expansion bypass - signals route from the FPGA
```

“C” Example

```
int    nHandle, nStatus, i;
DWord    dwData[4], dwTristate[4], dwInput[4];

GxFpgaInitialize (12, nHandle, nStatus);  \\ Initialize driver for instrument in slot #12
GxFpgaLoad (nHandle, 0, "Static_IO.svf" ,0,, pnStatus);  \\ Load SVF file to volatile FPGA memo
GxFpgaSetExpansionBoardBypass (nHandle , 0xF, pnStatus);  \\ Set the expansion bypass
for(i=0;i<4;i++){  \\ Repeat for port A - D
    GxFpgaWriteRegister (nHandle ,i*4, dwData[i], 4, nStatus);  \\ Write to Data Latch WE[i]
    GxFpgaWriteRegister (nHandle ,(i+4)*4, dwTristate[i], 4, nStatus);  \\ Write to Tristate La
}
```



Questions ?

A tradition of excellence