

Title



# **Digitizing Prevas frequency band shifter using LabVIEW FPGA**

**Hans Nystrom (Prevas)**

## IN BRIEF

- Founded in 1985
- Nordic leader in Embedded Systems
- Nordic leader within MES, EMI and Automation
- 500 employees – Sweden, Norway, Denmark, India and Dubai.
- Listed on NASDAQ OMX
- ISO 9001:2008 Certification

## INNOVATION FOR GROWTH

In industry, small innovation-driven companies and multinational exporters alike are faced with great challenges.

In order to survive, they are forced to continually develop new, innovative products, as well as more intelligent production methods and processes.

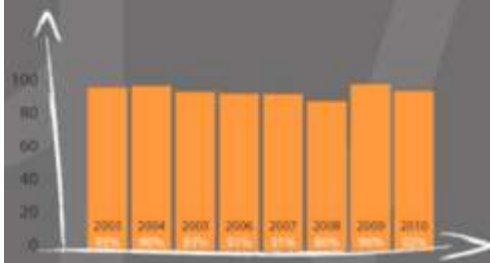
Prevas has since 1985 succeeded in developing more than 4,000 products, many of which have helped our customers become global leaders and to the same extent, we have contributed to higher levels of productivity, quality and profitability at our clients' facilities.

We call it *Innovation for Growth*.

## FACTS

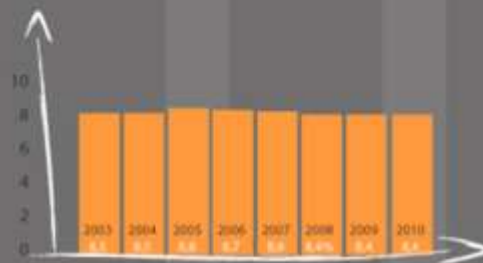
### 9 out of 10 projects on time

Compared to 4 out of 10 IT-projects as a market average



### Satisfied customers

Consistently scoring around 9 out of 10 in customer satisfaction surveys





## TEST SYSTEM DESIGN

For more than 15 years we have pursued on our believe that a test system needs to be build upon open architectures.

This pursuit has enabled us to provide test systems to our clients with superior flexibility, degree of customization, lifetime and cost/performance ratio.

As a leading company providing test solutions with a long experience in test strategies, we have both the knowledge and the resources to provide you with a competitive test solution that will fit your organization and products.

**For more information, please contact us at:**  
**[testsystem@prevas.se](mailto:testsystem@prevas.se)**





PXI Platform

# PXI PLATFORM

**Controller**

**Realtime, Linux, or Windows**



PC link

Controller

**PXI**

**Bandwidth 132 MB/s**



Small PXI

**Chassis**

**PXIe**

**Bandwidth 4GB/s**



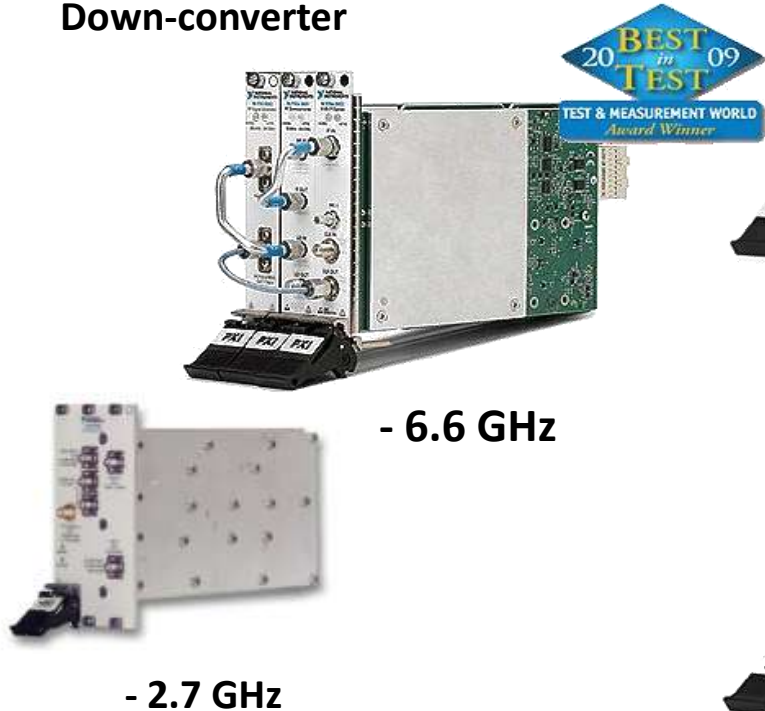
Large PXIe

RF Instruments for PXI

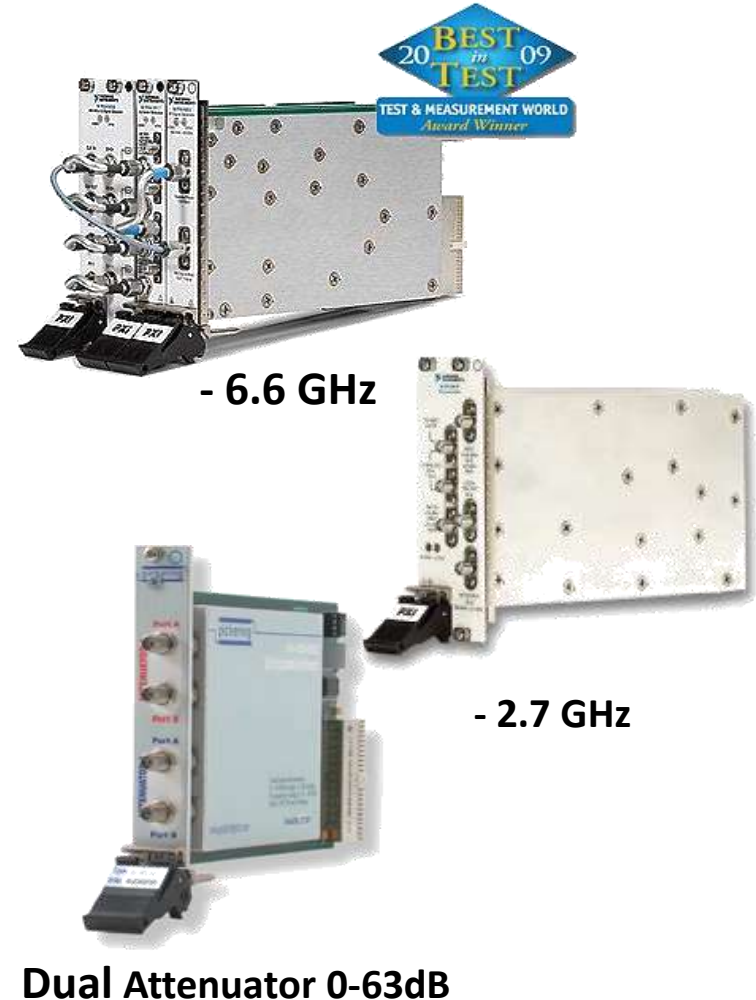


# RF INSTRUMENTS USING PXI(e)

Down-converter

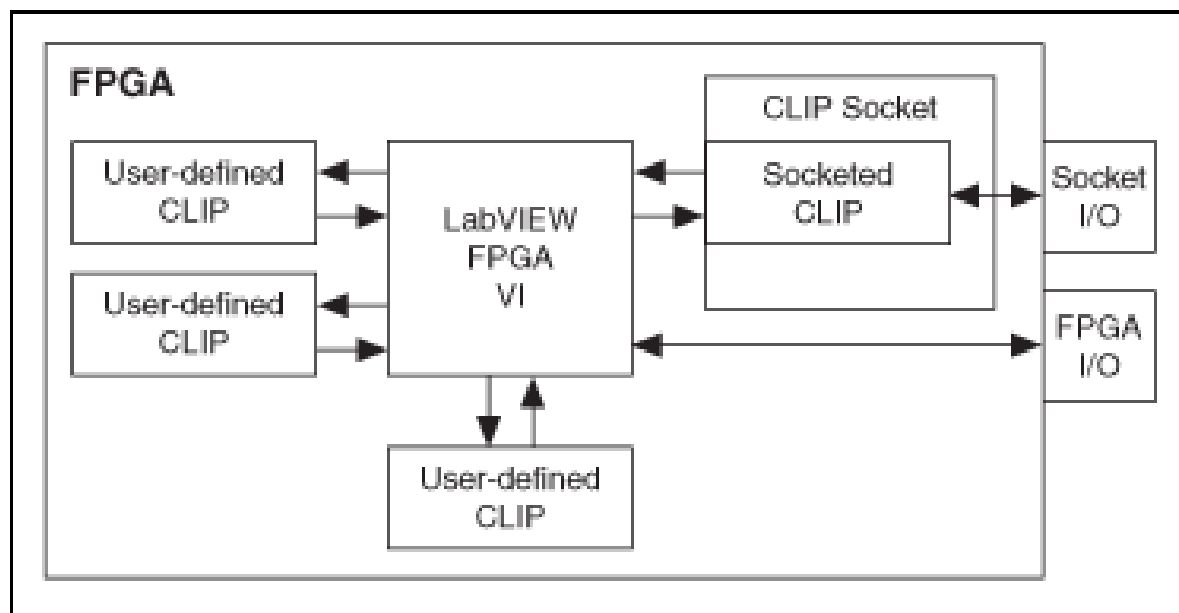


Up-converter





## NI FPGA TECHNOLOGY







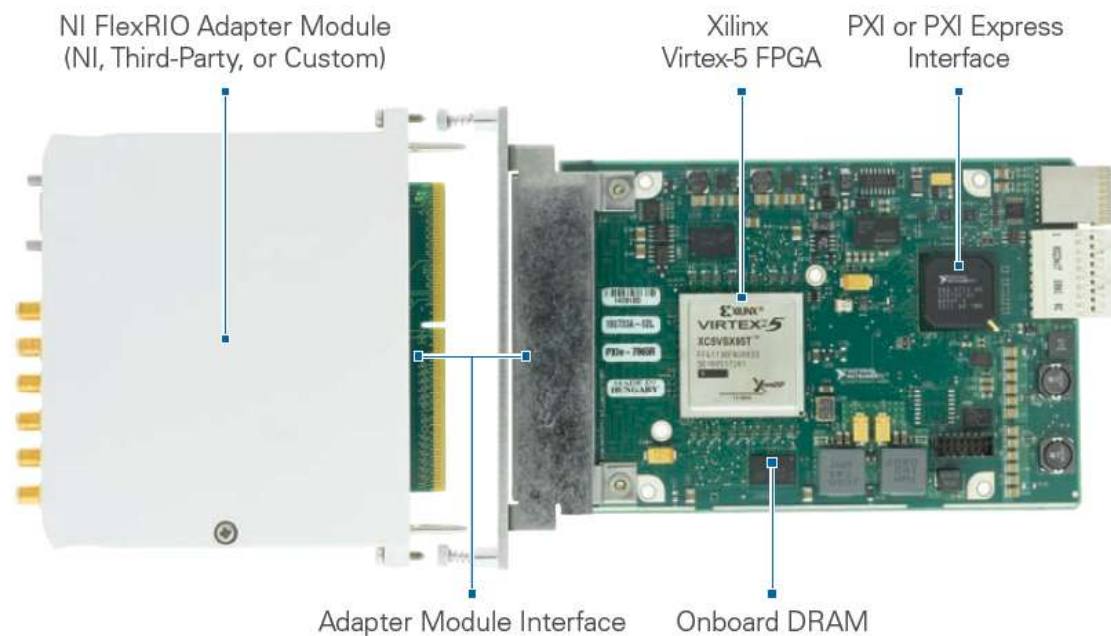
## FlexRIO

# NI FLEX RIO



### BaseBand Tranceiver

- Dual 100 MS/s, 14-bit inputs
- Dual 100 MS/s, 16-bit outputs
- 40 MHz bandwidth (-3 dB)



### Ni FlexRIO architecture



## NI FPGA Evolution

# NI FPGA EVOLUTION



Custom made for a non-standard  
(Japanese) T1/E1 HWY  
Designed and shipped 10 years ago with  
custom made FPGA boards.  
= Costly !



Today Platform for non standard interfaces

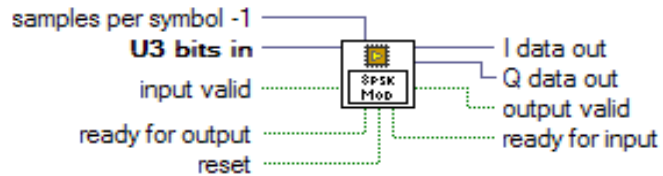


## RF IP Blocks



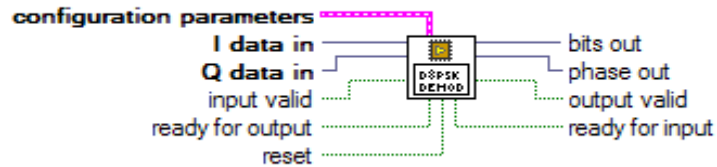
# RF IP BLOCKS

### niFPGARFv2 8PSK Modulator.vi



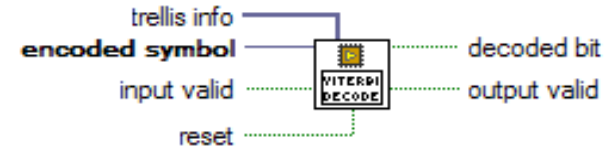
This VI performs 8-PSK modulation on a given bit stream.

### D8PSK Demodulator [niFPGARFv2 D8PSK Demodulator.vi]

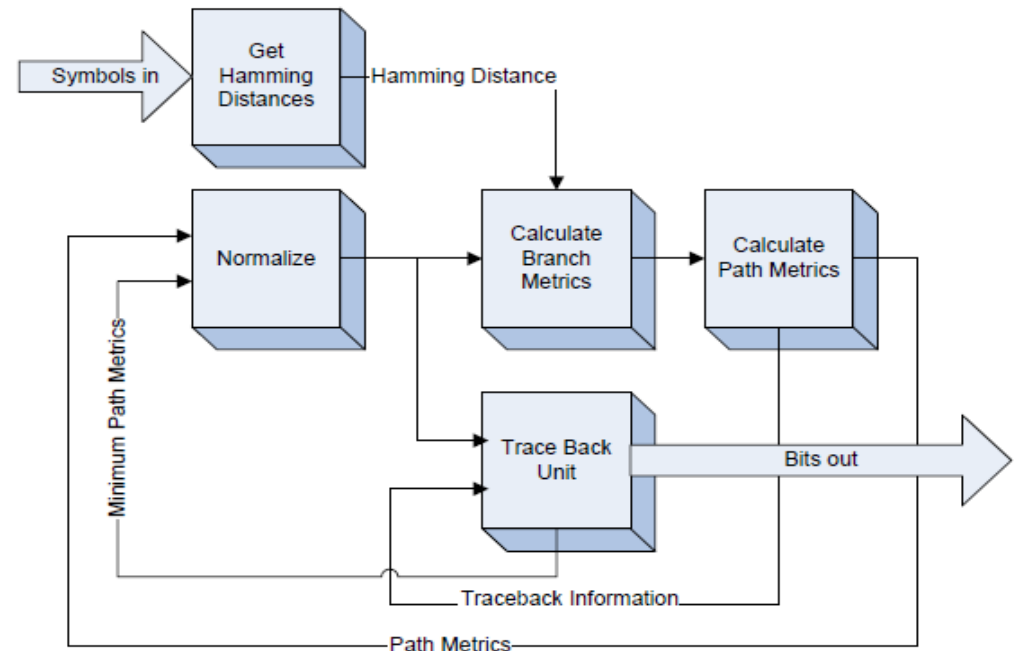


This VI performs demodulation of a differential 8-PSK modulated signal.

### niFPGARFv2 Viterbi Decoder [Generic fo K=7].vi



This VI decodes the convolutional encoded bits with the following parameters  
Code rate= 1/2  
Constraint length (K)=7





# REASON FOR SHIFTING FREQUENCY BAND

## *Overview*

Today there are many technologies using RF for communication. Communication standards such as Bluetooth, W-lan, GSM/3G, ZigBee, wimax. Broadcast standards using ordinary FM or digital such as DAB, DVB etc. **In general more and more communication is wireless.**

The RF frequencies of transmitting equipment are **government regulated** and are different between global regions. Normally this requires different type or versions of a specific product for different markets. In order to test the RF functionality of each product a RF based simulator may be used.

The simulator can be a commercial available product, a commercial simulator or a custom built solution.

However in many cases the frequency range of this equipment is limited and can therefore not test all required frequency bands.

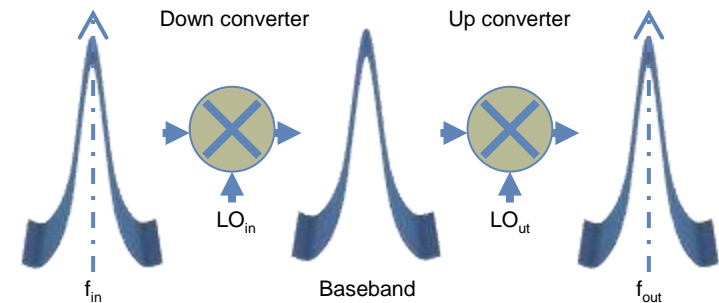
## The Frequency shifter



# THE FREQUENCY SHIFTER

## *The Challenge*

Development of equipment able to shift frequency of both transmitted and received RF signals.

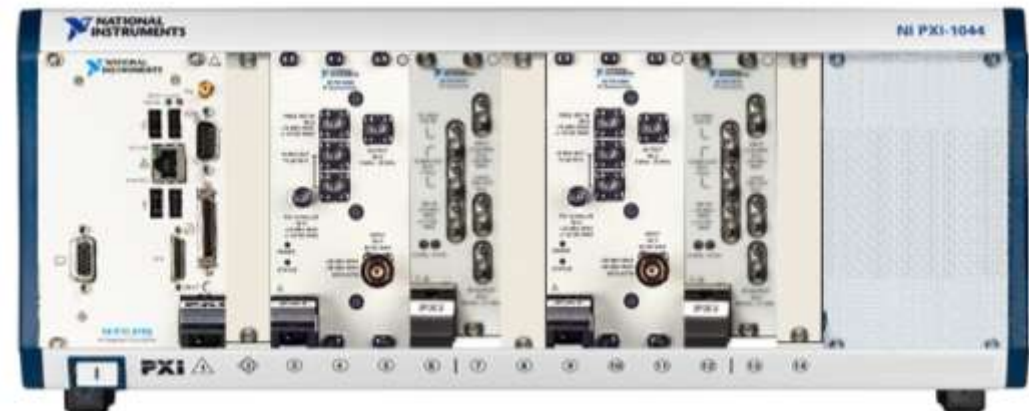


Each signal from any frequency 500MHz-2.7GHz to any frequency 500MHz-2.7GHz.  
Operated by GUI or Remote control (Ethernet)

## *System Description*

PXI with 2 uplink and 2 downlink converters from National Instruments.  
LO tuning of the down converter in to optimize the system performance.

**LabVIEW application with a GUI and remote control (Ethernet) with frequency preset setting**





Next generation, The Digital Frequency (Band) shifter

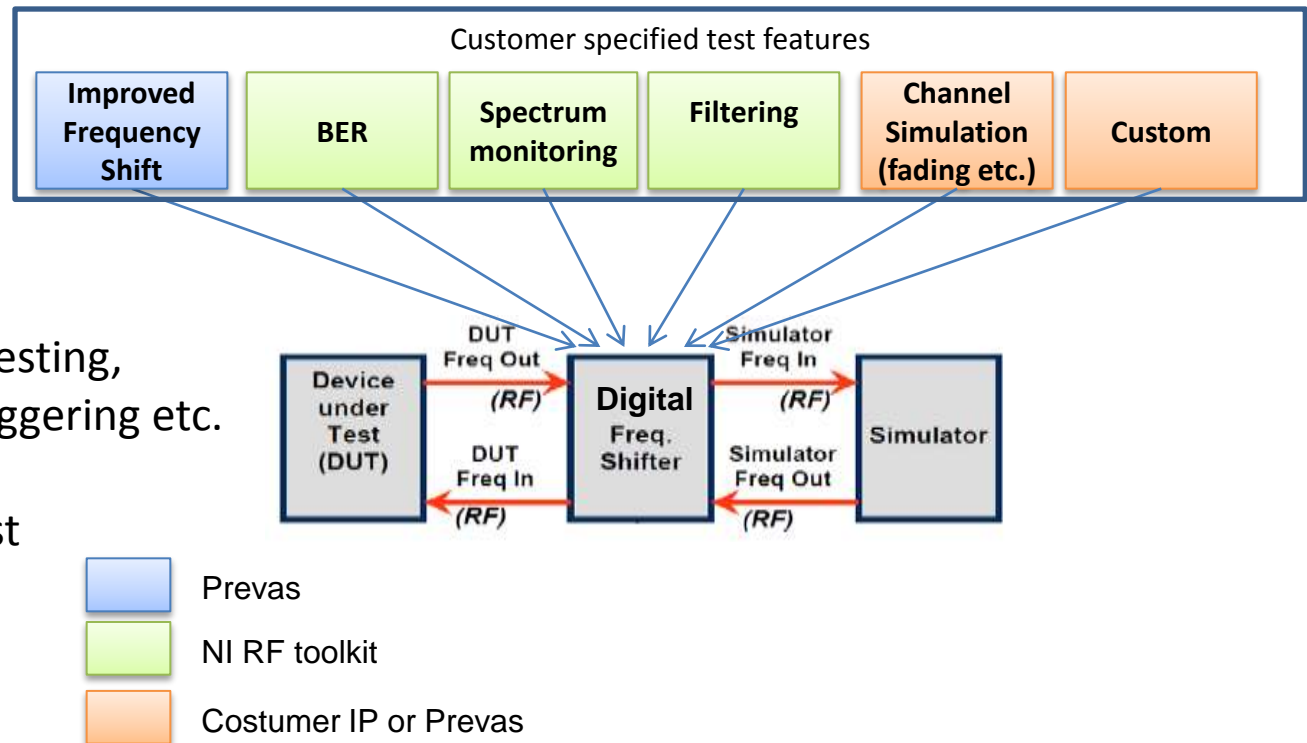
# NEXT GEN. THE DIGITAL FREQUENCY (BAND) SHIFTER

## *The new Challenges*

Development of equipment able to shift frequency in finer steps of both transmitted and received RF signals.

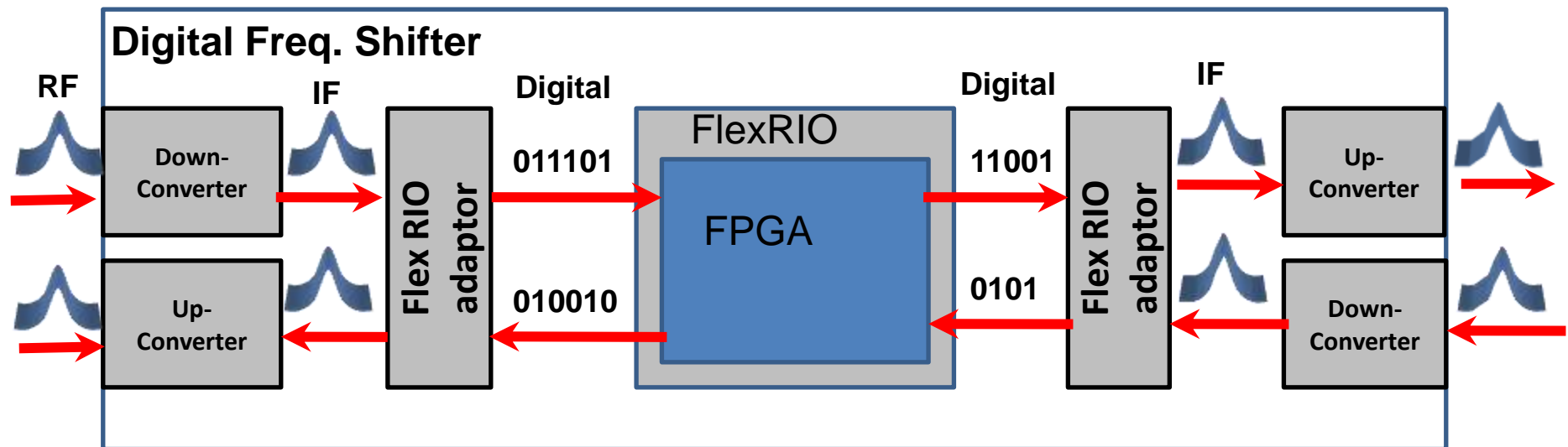
Add costumer specific features on both paths to perform tests such as RF channel emulation, filtering, modulation and demodulation, bit error testing, spectral monitoring or triggering etc.

Be able to do the new test features in real time.





# HARDWARE ARCHITECTURE

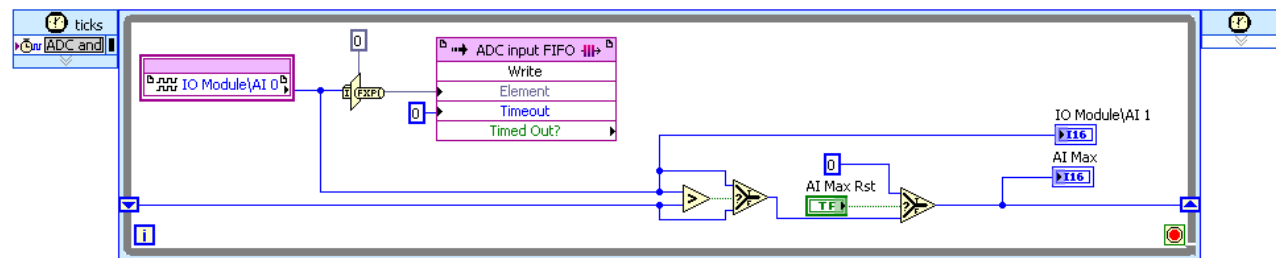


## The Digital Path

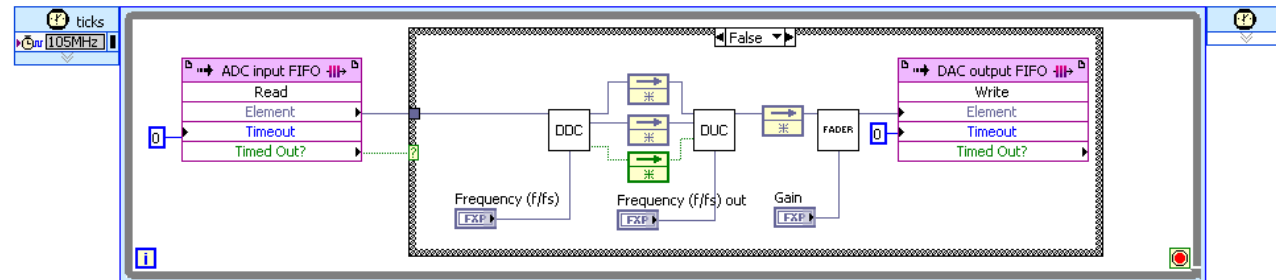


# THE DIGITAL PATH

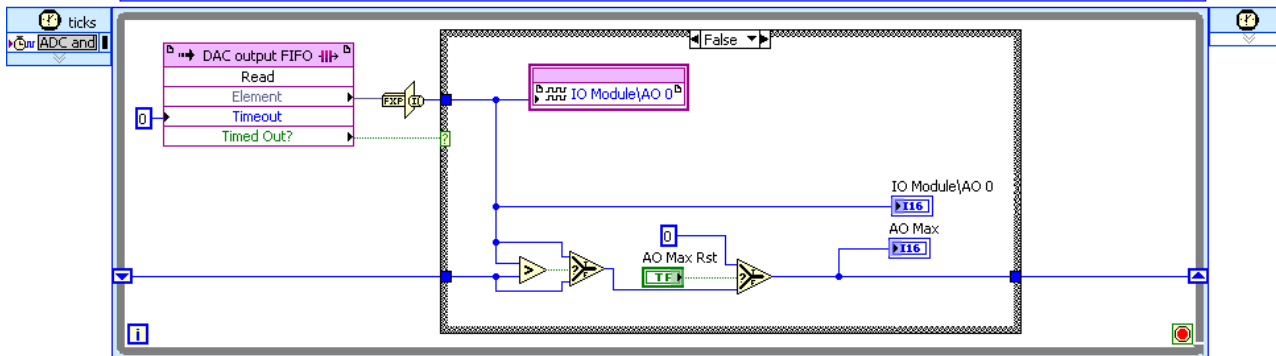
Digital input Path



Digital process Path



Digital output Path

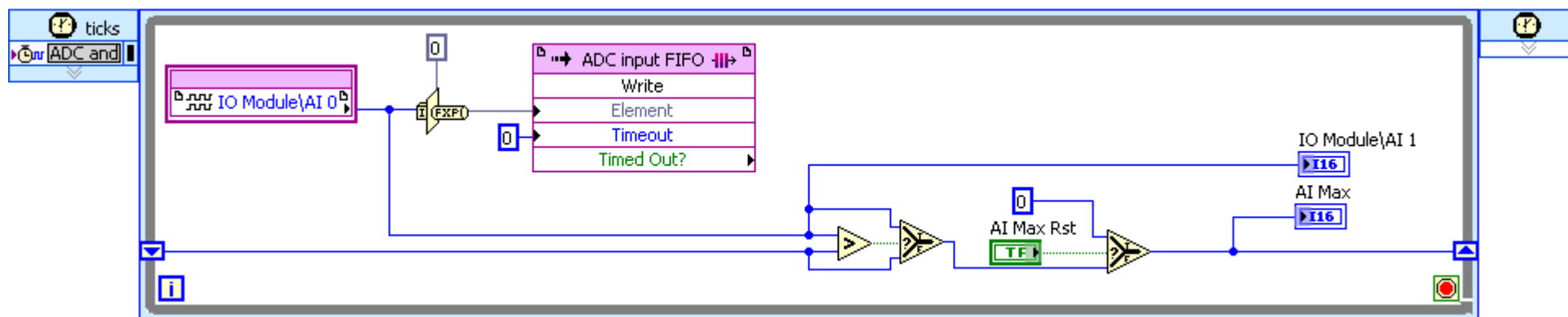




## The Digital Path

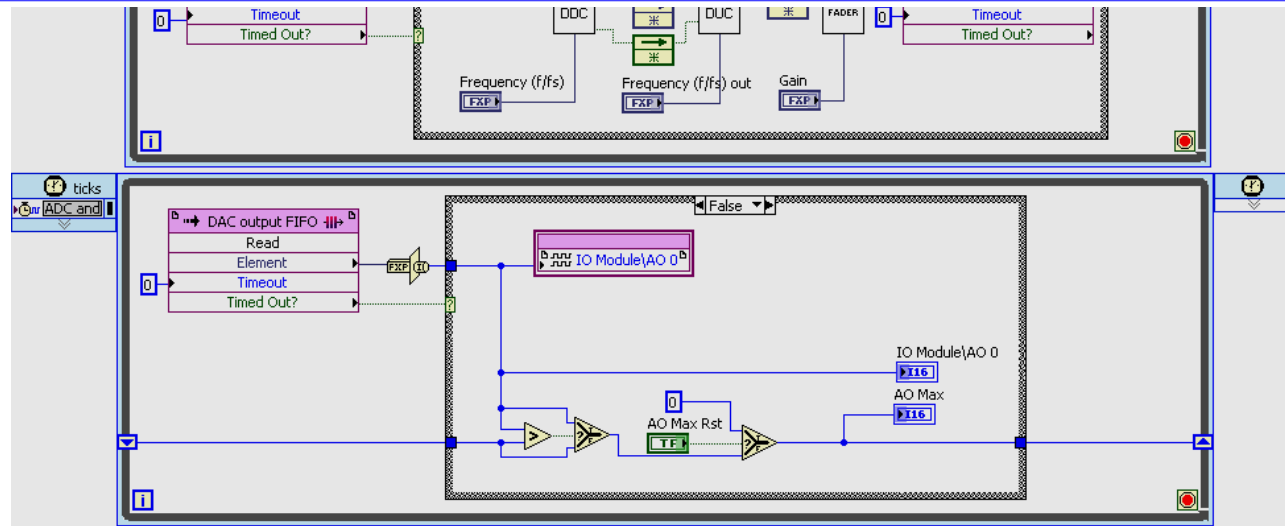


# THE DIGITAL INPUT PATH



Digital process Path

Digital output Path

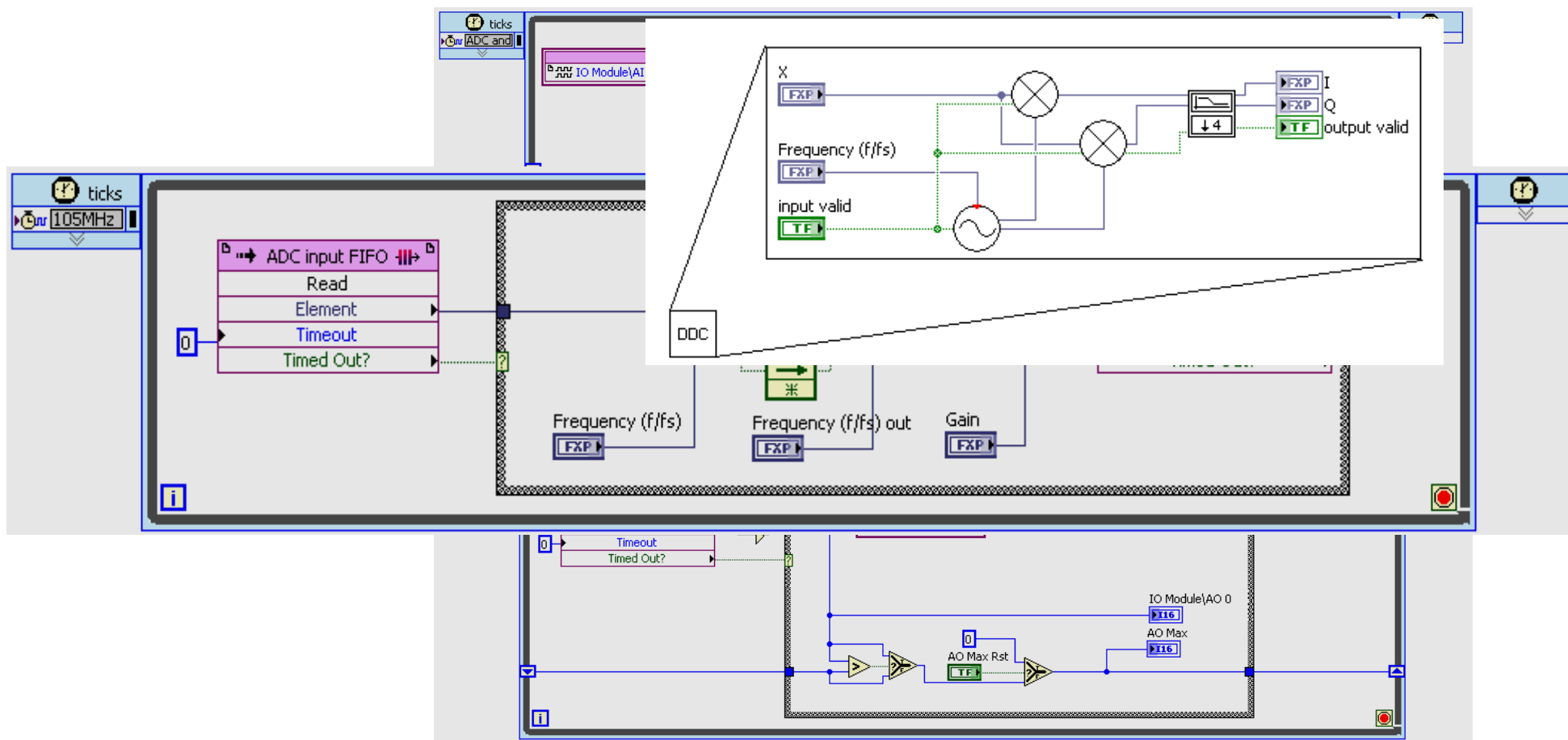


[illegible]

## The Digital Path



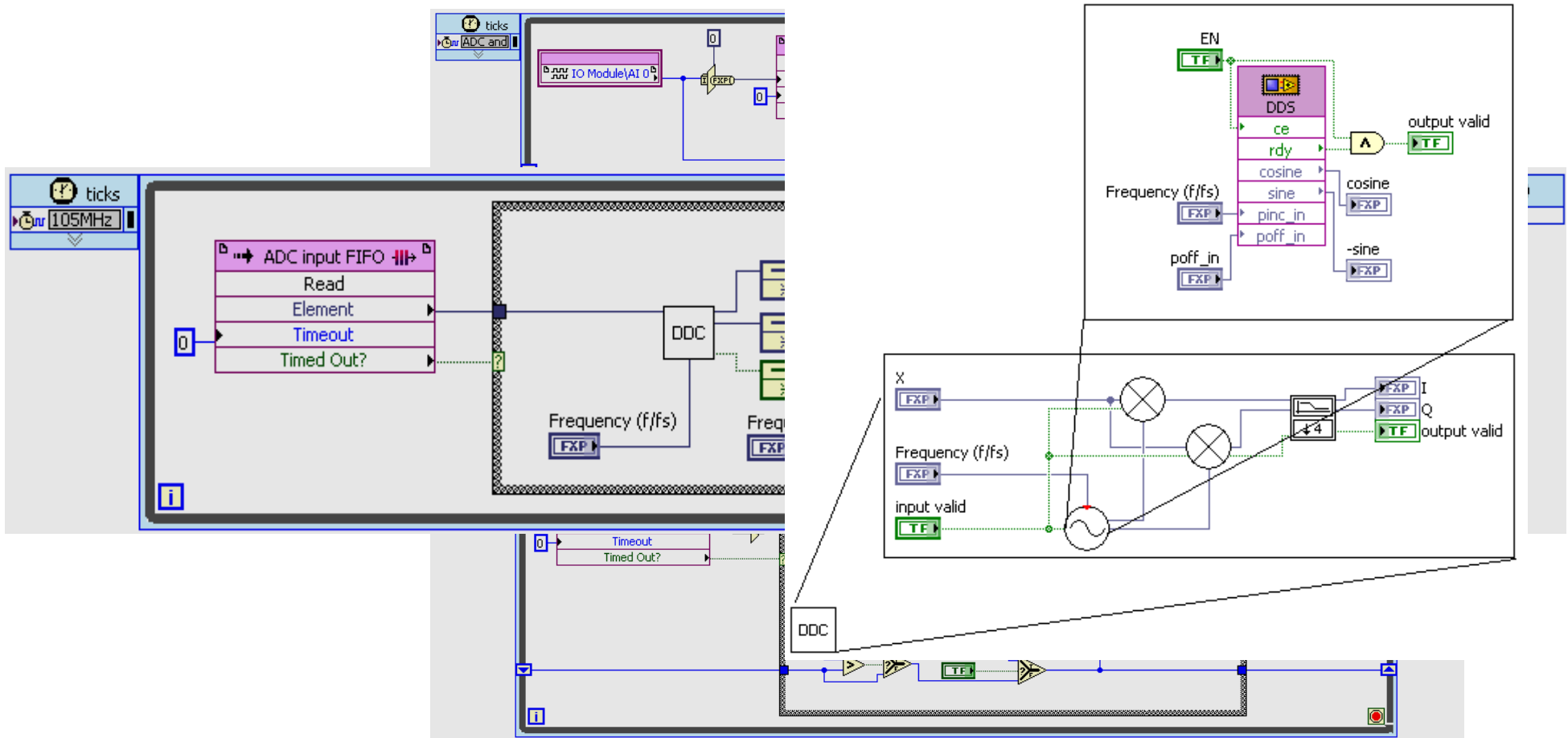
# THE DIGITAL PROCESS PATH, DDC



## The Digital Path



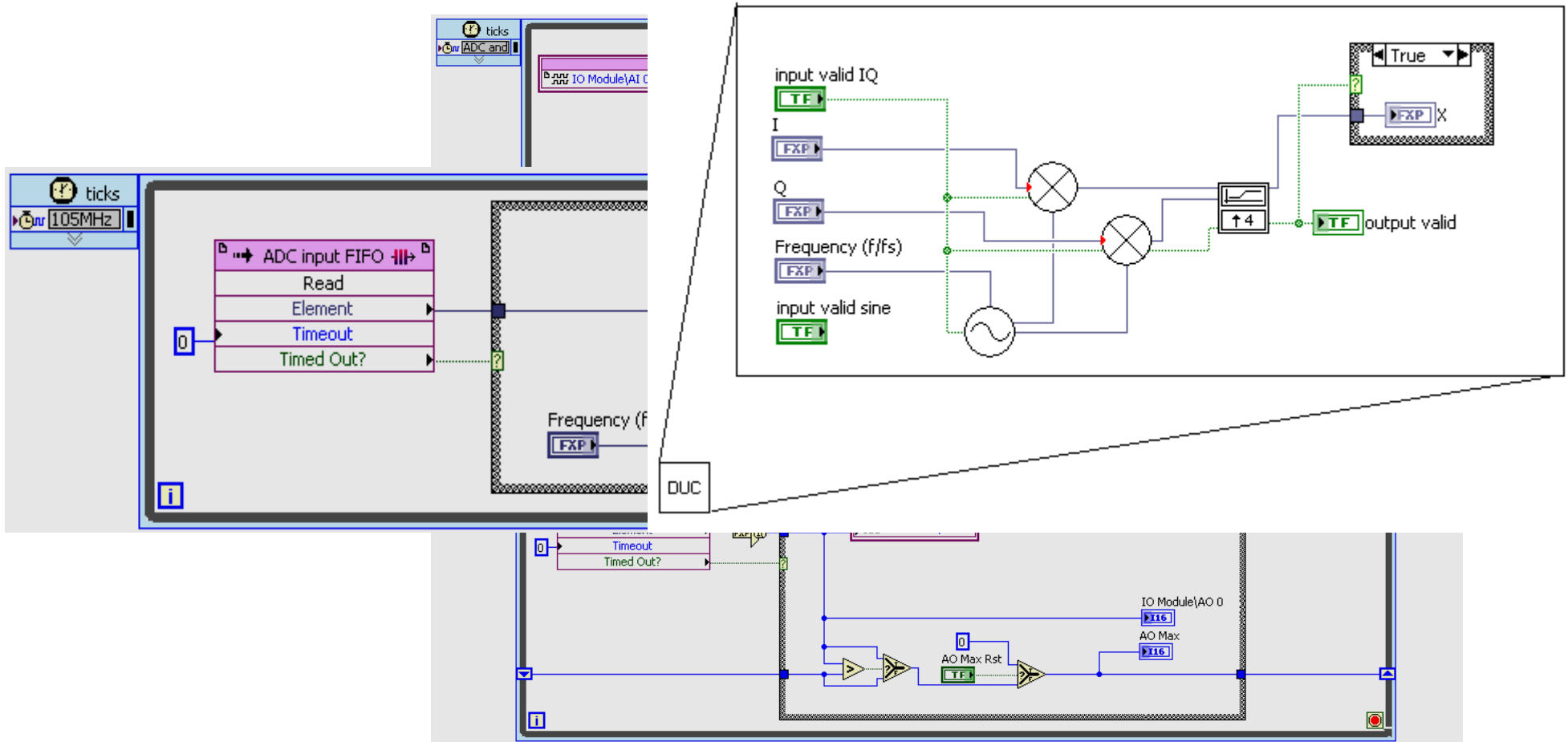
# THE DIGITAL PROCESS PATH, SYNTESIZER



## The Digital Path



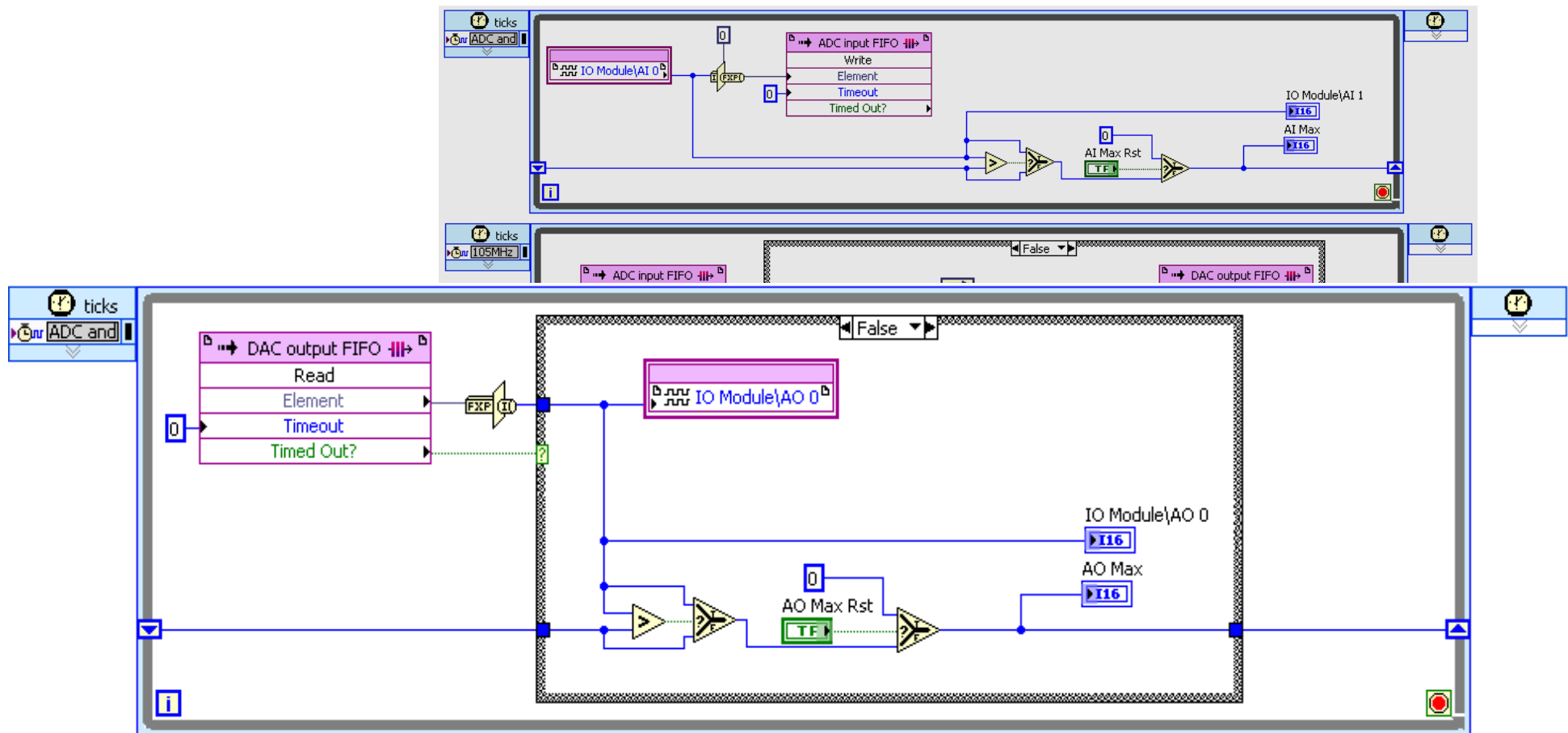
# THE DIGITAL PROCESS PATH



## The Digital Path



# THE DIGITAL OUTPUT PATH







## NEW APPLICATIONS

- Signal simulations
  - Path to path
  - Path to multipath
  - Custom RF modulation
- Realtime measurements
  - BER
  - Spectral monitoring

## Other PXI RF Systems



# MEDFIELD

**Development of a research measurement system examining the brain using microwave measurements equipments.**



**The system is made using the latest commercial available equipment and tools such as LabVIEW and PXI**

**The product Prevas developed for Medfield used a Vector Network Analyzer developed during the same period at National Instruments.**

**As a result the Medfield product were released at the same time as the Vector Network Analyzer product were released by National Instruments**

**["Click to see the product in YouTube"](#)**

