

# ARDUINO UNO : un interface de communication pour LabVIEW ?

[Journée AlpesVIEW/CNRS 2015](#)

### Problématique de recherche :

Pour une expérience de spectroscopie cohérente dans laquelle on utilise la technique de mélange à quatre ondes avec une détection hétérodyne et de la spectrométrie interférométrique.

Il nous **faut piloter des modulateurs acousto-optique (en fréquence, amplitude et phase) via un mixer radio-fréquence.**

### Problème technique :

Fréquence typique de fonctionnement: **80-110 MHz.**

Opérations : combinaisons linéaires **avec trois fréquences RF** ( $w_1, w_2, w_3$ ),  
typiquement  $2w_2 - w_1$ ,  $w_3 + w_2 - w_1$ ,  $3w_2 - 2w_1$  etc...

Réjection du bruit et des harmoniques parasites : **70 dbm.**

### Solutions possibles :

Il y a au moins 3 stratégies pour monter un tel appareil.

i) La version analogique. Un problème peut se poser au niveau du "phase shifter" qui entraîne une variation du signal de sortie

ii) **La version générateur et mixeur numérique**

iii) La dernière solution consiste en l'achat de la détection synchrone de Zurich Instrument  
(<http://www.zhinst.com/products/hf2li>).

Cette dernière peut être dérivée de son utilisation classique pour générer 3 fréquences RF et de réaliser, sur ces dernières, des combinaisons linéaires et des déplacements en phase.

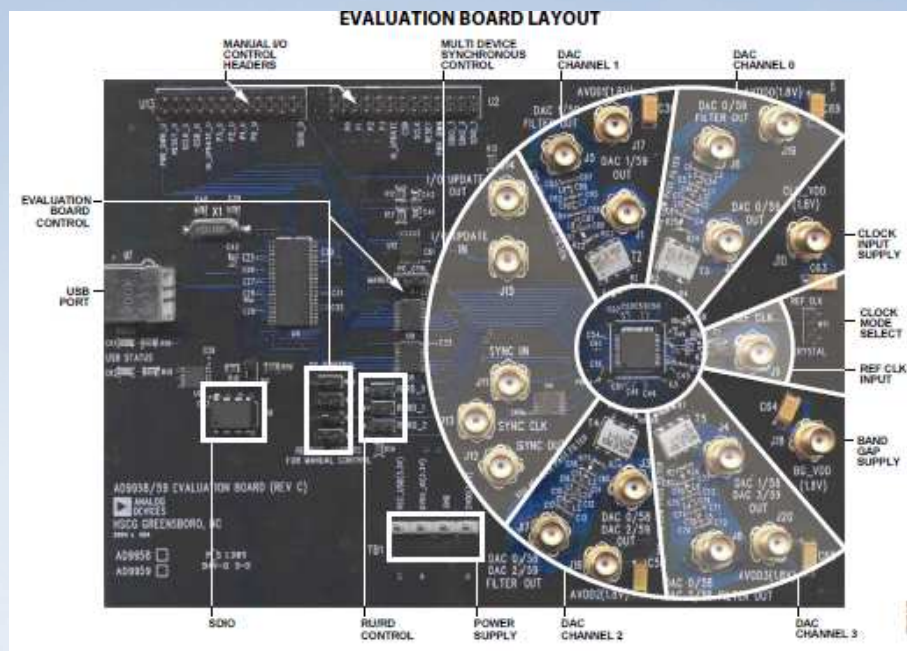
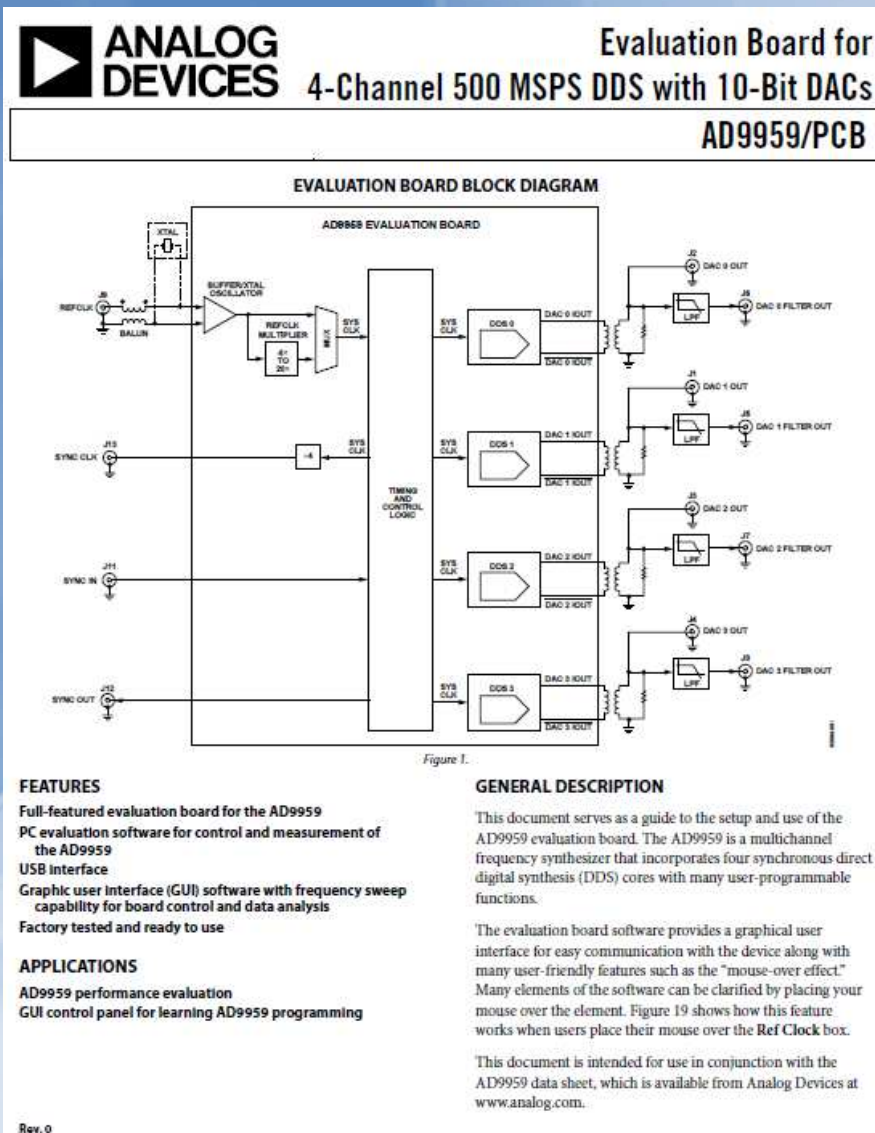
### Choix :

La version 1 suppose un savoir-faire dans les techniques RF, ce qui n'est pas le cas,

La version 3 est trop onéreuse (le lock-in vaut environ 30 000€) et disproportionnée par rapport au problème.

C'est donc la version **2** qui est choisie .

## Solution choisie : La carte d'évaluation **AD9959/PCBZ** d'Analog Devices :



Dimensions : 165X115 mm  
 Alimentations : 5V, 3.3V et 1.8V  
 Interfaces USB et SPI

## Le composant actif: AD9959 :

### FEATURES

4 synchronized DDS channels @ 500 MSPS  
Independent frequency/phase/amplitude control between channels  
Matched latencies for frequency/phase/amplitude changes  
Excellent channel-to-channel isolation (>65 dB)  
Linear frequency/phase/amplitude sweeping capability  
Up to 16 levels of frequency/phase/amplitude modulation (pin-selectable)  
4 integrated 10-bit digital-to-analog converters (DACs)  
Individually programmable DAC full-scale currents  
0.12 Hz or better frequency tuning resolution  
14-bit phase offset resolution  
10-bit output amplitude scaling resolution  
Serial I/O port interface (SPI) with enhanced data throughput

Software-/hardware-controlled power-down  
Dual supply operation (1.8 V DDS core/3.3 V serial I/O)  
Multiple device synchronization  
Selectable 4× to 20× REFCLK multiplier (PLL)  
Selectable REFCLK crystal oscillator  
56-lead LFCSP package

### APPLICATIONS

Agile local oscillators  
Phased array radars/sonars  
Instrumentation  
Synchronized clocking  
RF source for AOTF

### FUNCTIONAL BLOCK DIAGRAM

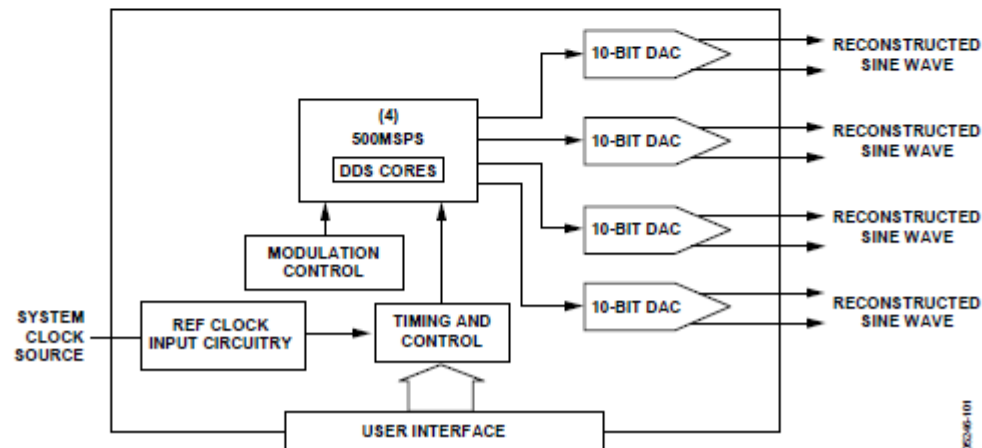


Figure 1.

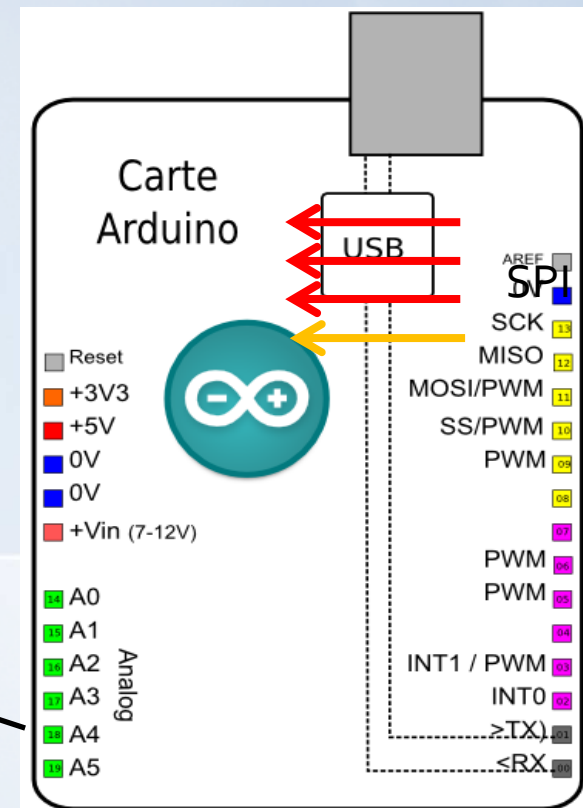


Le logiciel d'évaluation fourni par Analog Devices n'est pas « intégrable » dans un programme LabVIEW pilotant les autres paramètres ou servant aux mesures,  
Le programme en C est très touffu pour l'utiliser rapidement et l'objectif était de piloter la carte **par LabVIEW (2013)**.

Cette carte peut être pilotée également par une **liaison série SPI 3 fils**.  
**Un ARDUINO UNO** attendait « sur l'étagère » : il faut le piloter en LabVIEW.



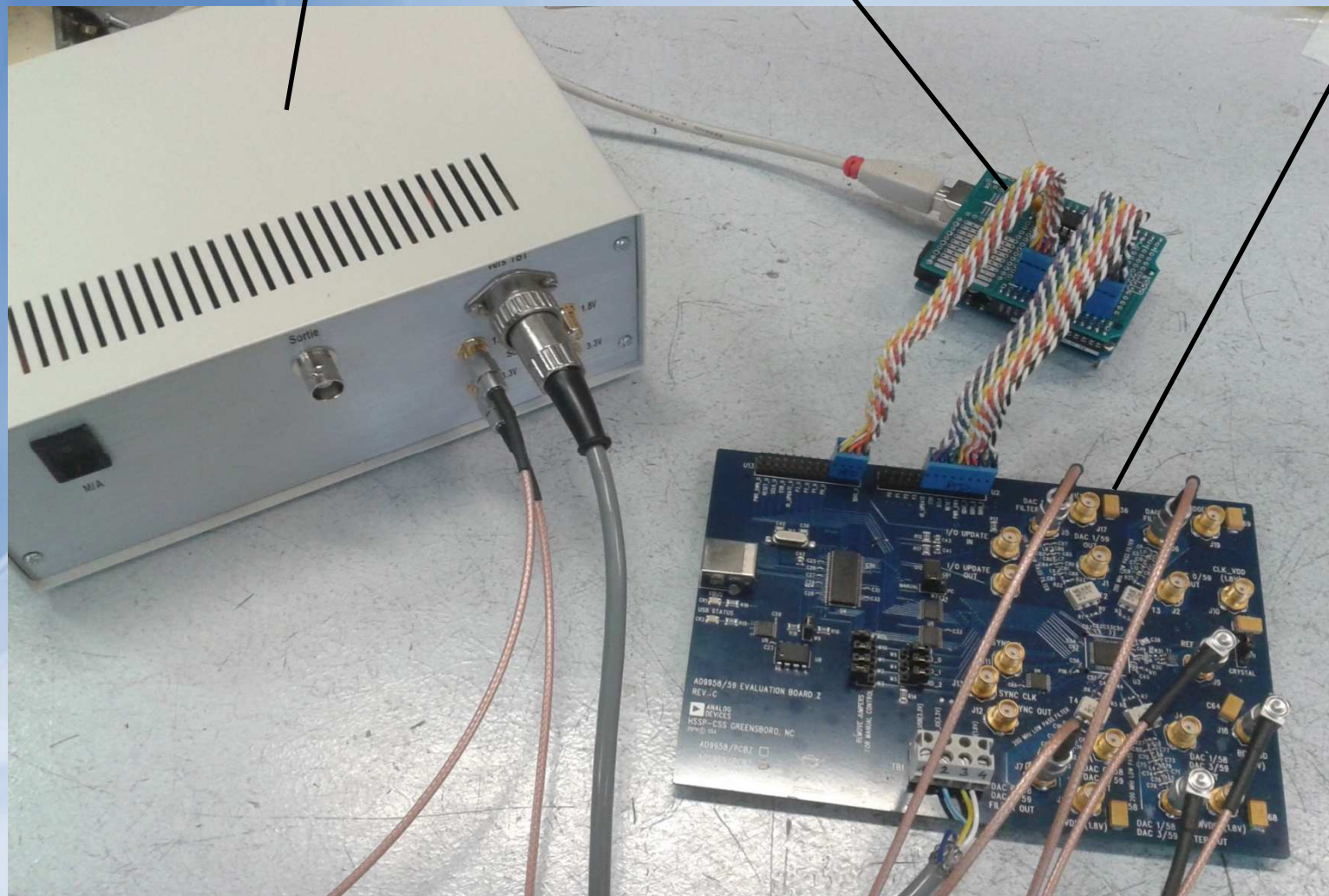
6 Analog IN 10bits  
0-5V



**Alimentation  
5V, 1.8V, 3.3V**

**ARDUINO UNO +  
interface sur carte  
shield**

**AD9959/PCBZ**



## Logiciel Analog Devices (AD9958 59 Setup1.0 / Windows 32bits)

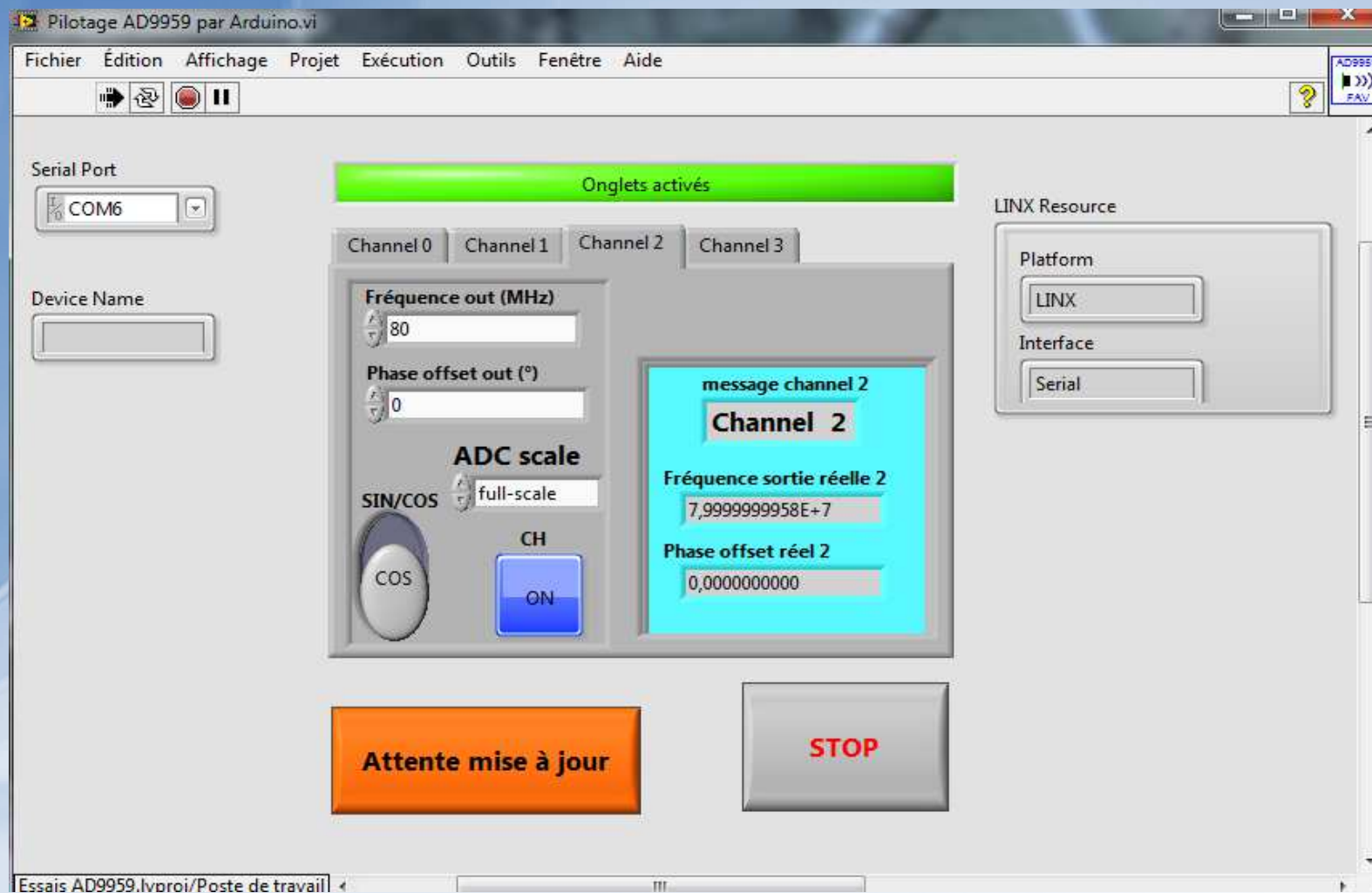
The screenshot displays the AD9958 59 Setup1.0 software interface, which is a 32-bit Windows application. The main window has a menu bar (File, I/O, View, Help) and a toolbar with icons for file operations and a 'Master Reset' button. Below the toolbar, there are checkboxes for 'Auto I/O Update' and 'Manual I/O Update'.

Three configuration windows are open:

- Chip Level Control:** This window contains settings for the clock (Ref Clock: 500,000 MHz, Multiplier: Disabled, CP Current: 75 uA, System Clock: 500,000 MHz, VCO Gain), power down controls (All Channel Power Down, Clock Input, DAC Ref, Disable SyncCLK Out, External PD Control, Power Down Pin Mode: Quick Recovery, Full Power Down, Power Down Pin), and modulation configuration (Profile Pin Config, RU/RD: Disabled, Level: 2-Level Mod, 4-Level Mod, 8-Level Mod, 16-Level Mod). It also has 'LOAD' and 'READ' buttons.
- Channel Output Config:** This window shows settings for four channels (Channel 0, Channel 1, Channel 2, Channel 3). It includes a 'Single Tone Setup' section with Frequency 00 (0.00000000 MHz), Phase Offset (1.000000 Deg), and Enable ASF (1.000000). It also has a 'Linear Sweep Setup' section with Rising Step Size (0.00000000 MHz), Rising Step Interval (0.000 us), Falling Step Size (0.00000000 MHz), and Falling Step Interval (0.000 us). The bottom section shows 'Profile and RU/RD Pin Control' with buttons for P0, P1, P2, P3, SDIO1, SDIO2, SDIO3, and an 'Auto' checkbox. It also has 'LOAD' and 'READ' buttons.
- Channel Control:** This window shows settings for four channels (Channel 0, Channel 1, Channel 2, Channel 3). It includes a 'Pwr Down' section with 'Digital' and 'DAC' options, a 'Pipe-Line Latency Control' section with 'Match Pipe Delays', and a 'DAC Full Scale Current Control' section with 'Full Scale', '1/2 Scale', '1/4 Scale', and '1/8 Scale' options. It also has a 'Modulation Output Type' section with 'None (Single Tone)', 'Amplitude', 'Frequency', and 'Phase' options, and a 'Linear Sweep Options' section with 'Enable Linear Sweep', 'Linear Sweep No Dwell', 'Load SRR @ I/O Update', 'Clear Sweep Accumulator', and 'Auto Clear Sweep Accumulator' options. It also has a 'Phase Accumulator Control' section with 'Clear Phase Accumulator' and 'Auto Clear Phase Accumulator' options. It has 'LOAD' and 'READ' buttons.

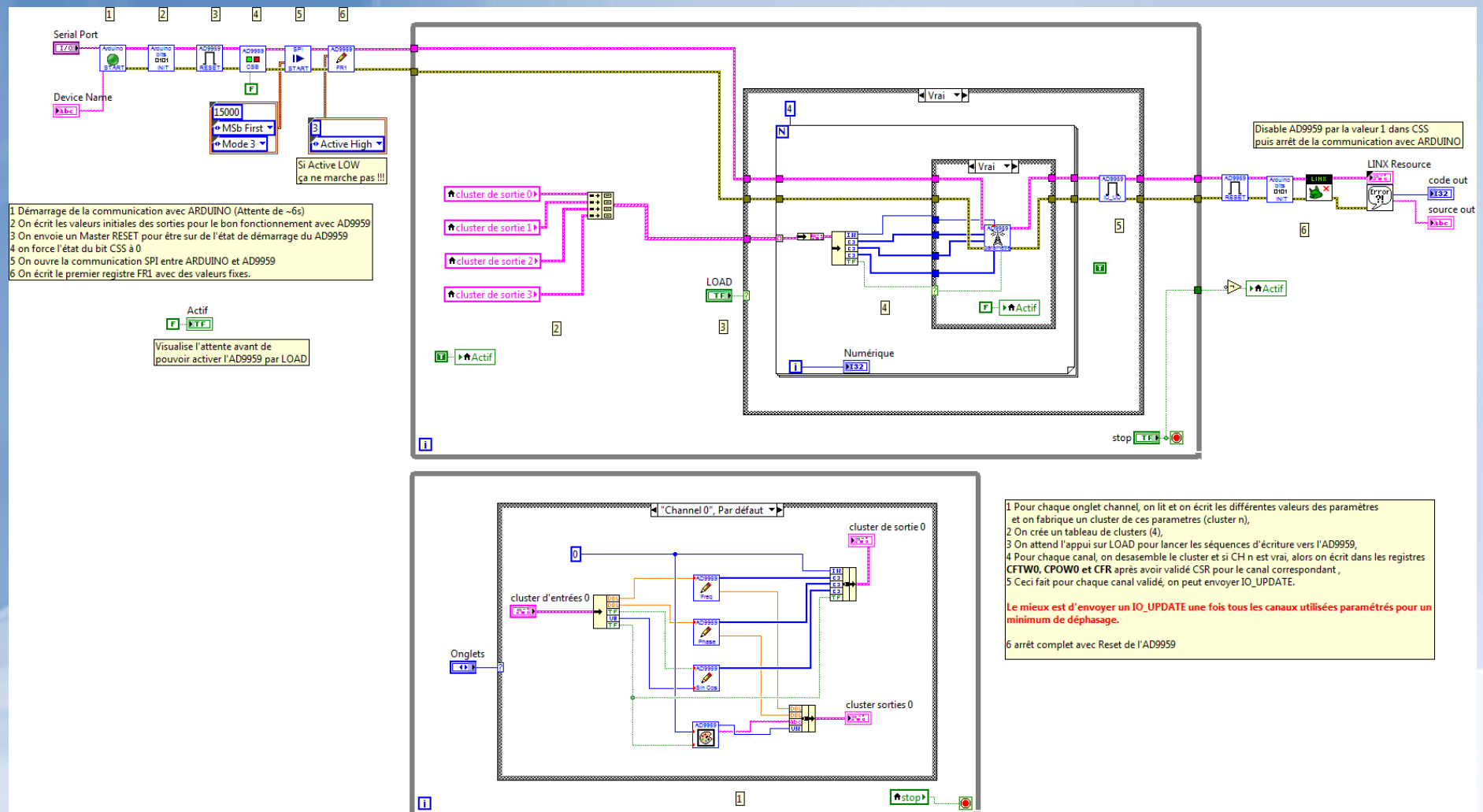


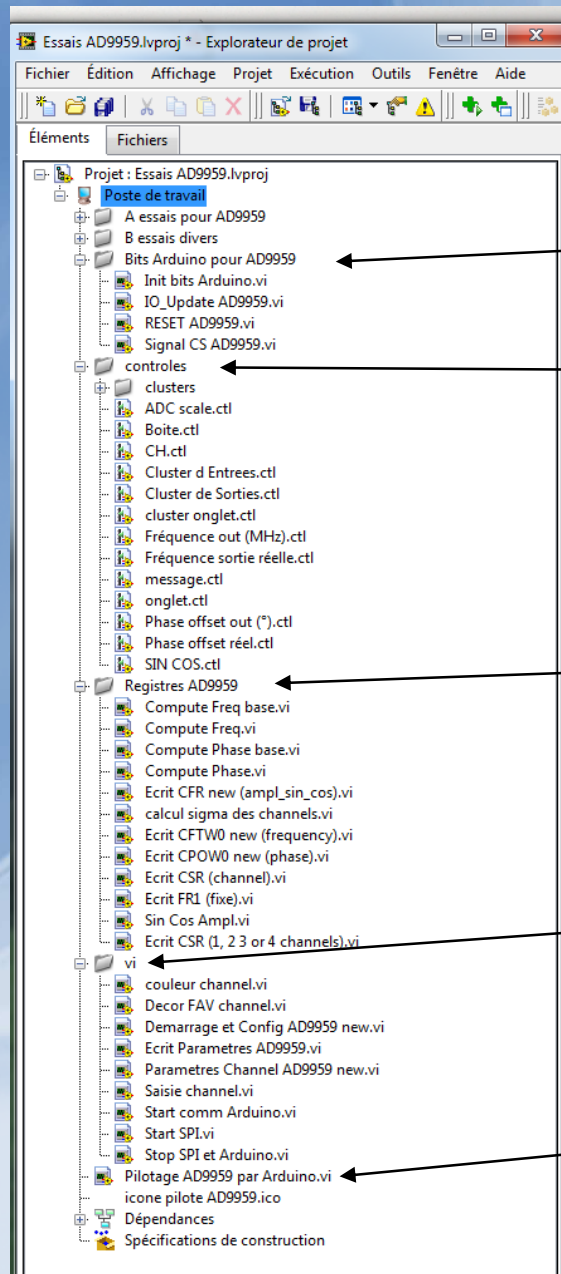
## Logiciel **LabVIEW** : Pilotage AD9959 par Arduino UNO / Face avant





# Diagramme





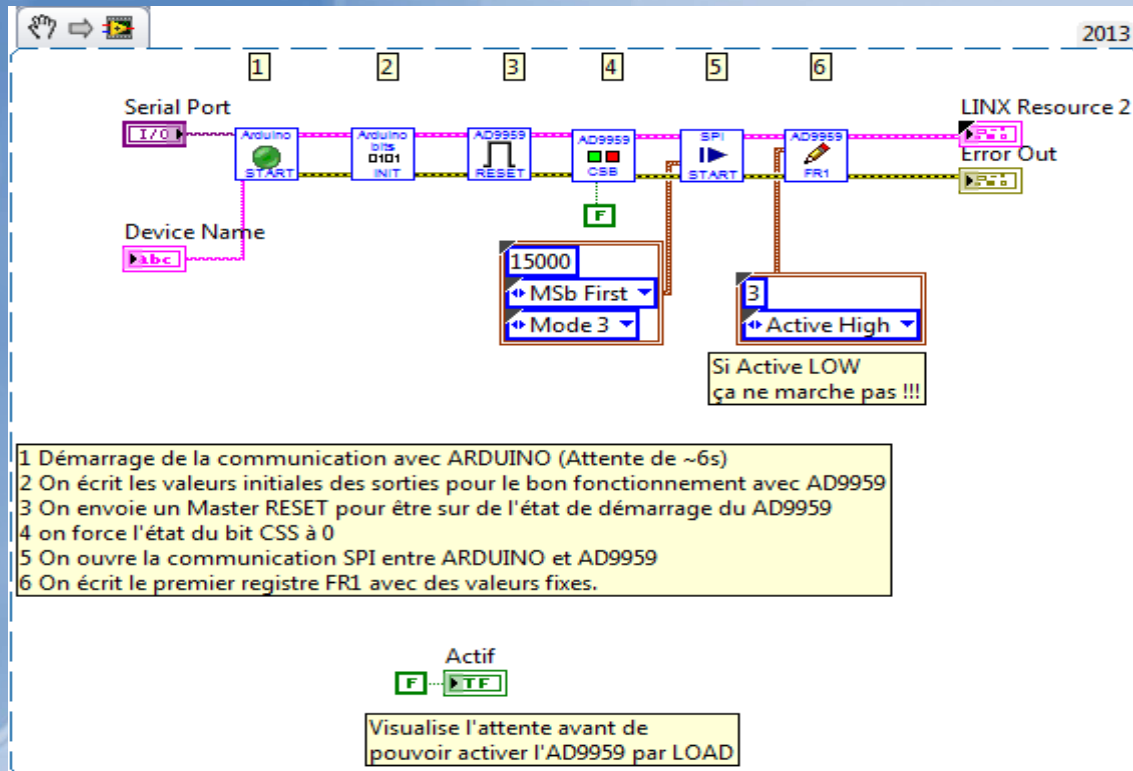
Les VI de définition des bits  
Arduino

Les différents  
contrôles

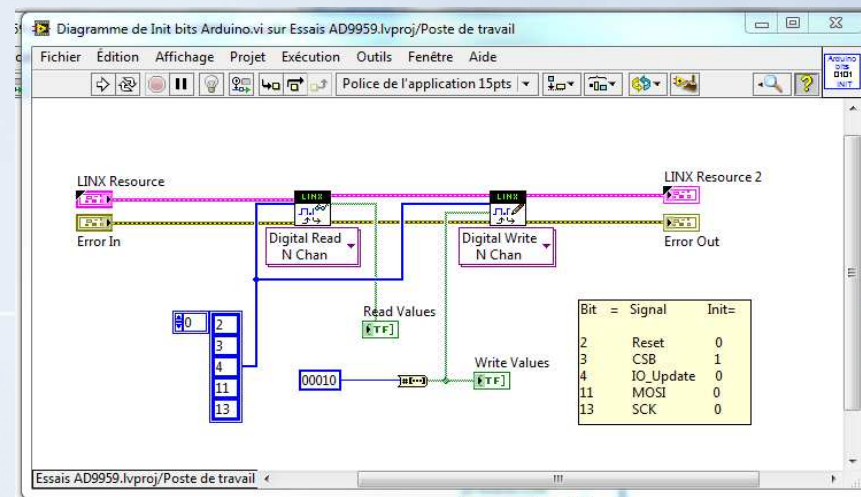
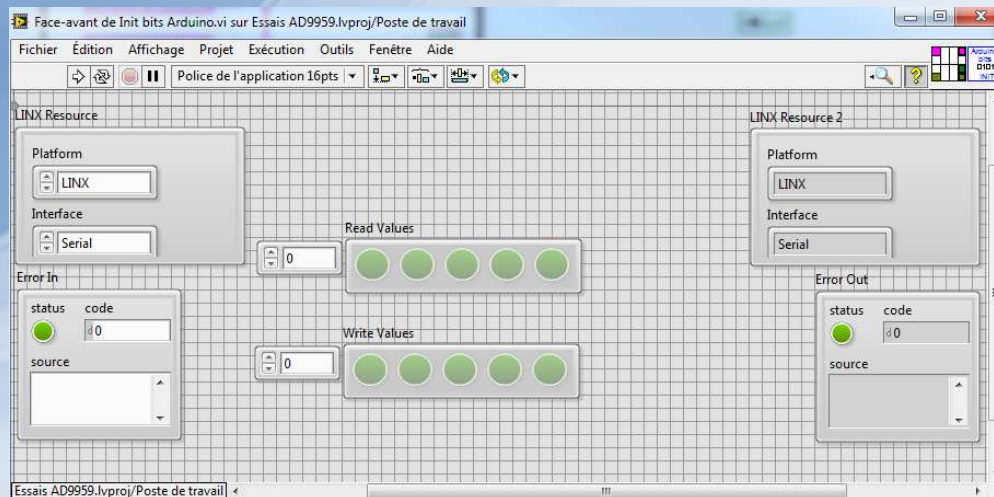
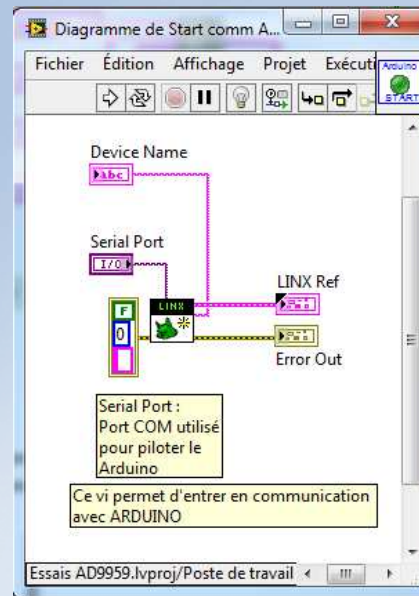
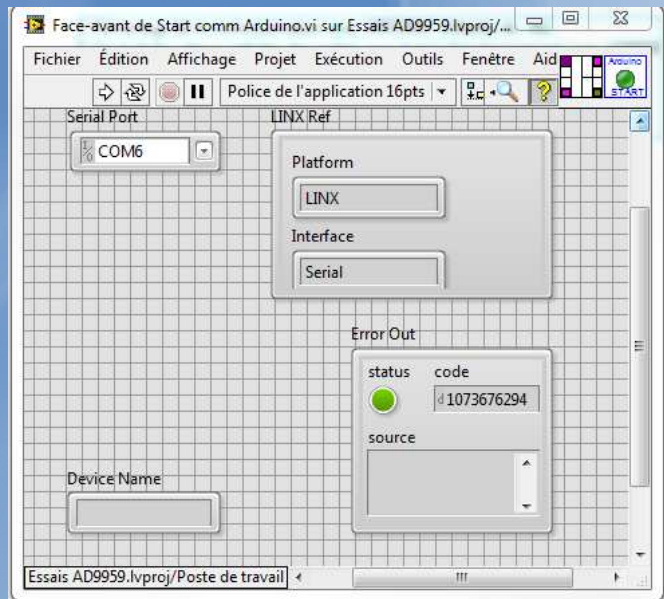
VI des registres du  
AD9959

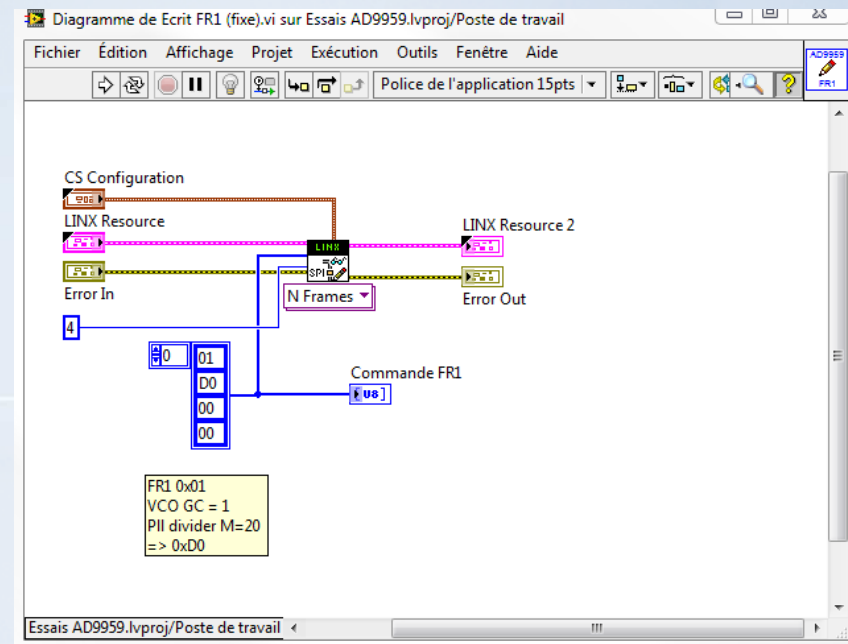
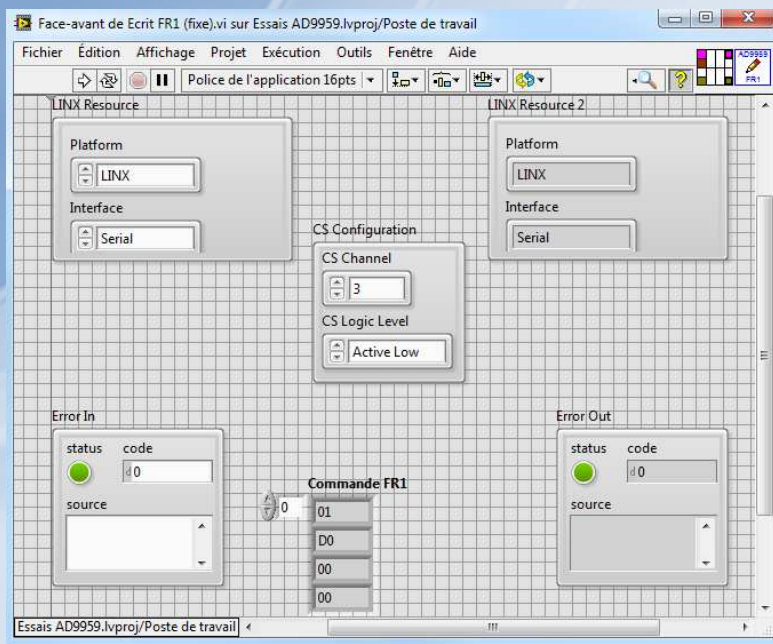
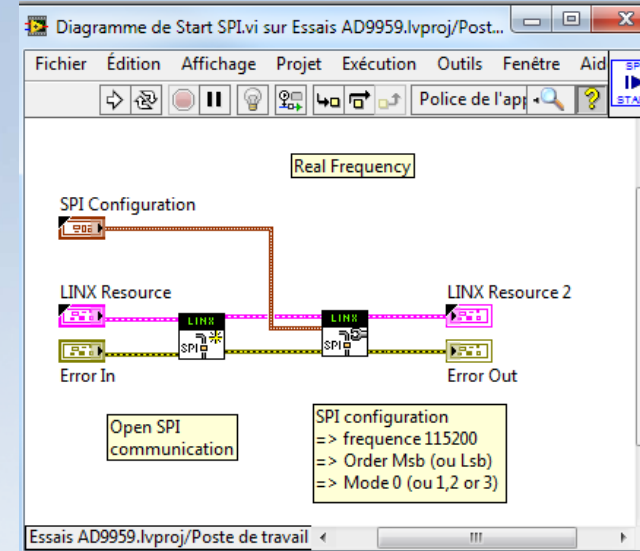
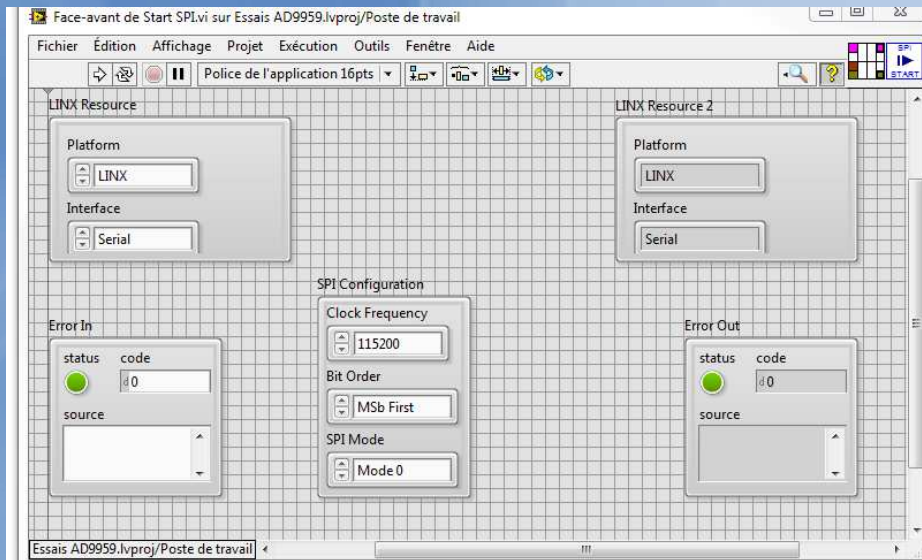
Les différents sous-vi  
principaux

VI Principal









## VI Package Manager

The screenshot displays the LabVIEW VI Package Manager (VPM) interface. The main window shows a list of packages with columns for Name, Version, Repository, and Company. The 'MakerHub LINX' package is highlighted in blue. A secondary window, titled 'JKI VPM - MakerHub LINX', provides detailed information about the selected package, including its version (v2.0.0.93), release date, author, copyright, license, and description. A 'VPM Legend' box is also visible, explaining the status of the package.

Name	Version	Repository	Company
jk_lbr_disconnect_from_typedef_recursive	1.0.1-1	JKI Package Network	JKI Labs
jk_lbr_justify_text	1.0.1-1	JKI Package Network	JKI Labs
jk_lbr_wire_error_case_structure	1.2.1-1	JKI Package Network	JKI Labs
jk_rsc_toolkits_palette	1.1-1	JKI Package Network	JKI Software
jk_tool_right_click_framework	1.0.2.208-1	JKI Package Network	JKI Labs
jk_tool_tortoiseshv	2.2.0.186-1	NI LabVIEW Tools Network	JKI
Kawasaki Robotics Library	0.2.0.59	NI LabVIEW Tools Network	ImagingLab
Kinesthesia Toolkit for Microsoft Kinect	1.0.0.5	NI LabVIEW Tools Network	University of Leeds
Kuka Robotics Library	2.1.0.9	NI LabVIEW Tools Network	ImagingLab
Kuka Robotics Library KR C4	3.3.0.21	NI LabVIEW Tools Network	Digimatrix
LabbitMQ	2.0.1.9	NI LabVIEW Tools Network	Distro
LabJack Utilities	2.1.3.11	NI LabVIEW Tools Network	Interface Innovations
LabSocket	3.4.1.77	NI LabVIEW Tools Network	Bergmans Mechatronics LLC
LabSocket-Basic	2.8.3.55	NI LabVIEW Tools Network	Bergmans Mechatronics LLC
LabVIEW Icon Version Overlay	1.0.0.15	JKI Package Network	JKI
LabVIEW Interface for Amazon S3	1.0.0.19	NI LabVIEW Tools Network	National Instruments
LabVIEW Interface for Arduino	2.2.0.79	NI LabVIEW Tools Network	National Instruments
LabVIEW Taskbar Progress bar API	2.1.0.9	NI LabVIEW Tools Network	NI
LAIVA Palette	1.0.0.1	NI LabVIEW Tools Network	LAIVA
Live HDF5	1.1.1.86	NI LabVIEW Tools Network	UPVI, LLC
LTE RBS	1.2.3.1	NI LabVIEW Tools Network	
LTK Localization Toolkit for LabVIEW	3.0.3.6	NI LabVIEW Tools Network	SEA
Lux UI Controls Suite	1.0.0.1	NI LabVIEW Tools Network	Ovak Technologies
Maker Hub Interface for Xbox One Controller	2.0.0.6	NI LabVIEW Tools Network	MakerHub
MakerHub Interface for Adept	2.0.0.49	NI LabVIEW Tools Network	MakerHub
MakerHub Interface for Kodi	1.0.0.5	NI LabVIEW Tools Network	MakerHub
MakerHub Interface for Leap Motion Controller	2.0.0.62	NI LabVIEW Tools Network	MakerHub
MakerHub Interface for Microsoft Kinect One	1.3.0.17	NI LabVIEW Tools Network	MakerHub
MakerHub Interface for Nest Thermostat	2.0.0.10	NI LabVIEW Tools Network	MakerHub
MakerHub Interface for PS4 Controller	2.0.0.3	NI LabVIEW Tools Network	MakerHub
<b>MakerHub LINX</b>	<b>2.0.0.93</b>	<b>NI LabVIEW Tools Network</b>	<b>MakerHub</b>
MakerHub Toolbox	2.0.0.35	NI LabVIEW Tools Network	MakerHub
Mat File Toolkit	1.0.1.13	NI LabVIEW Tools Network	Evalumation, LLC
Maxon EPOS2	1.1.0.15	NI LabVIEW Tools Network	Maxon Motor
MNI Toolkit	1.0.1.21	NI LabVIEW Tools Network	LiveTools.co.uk

**MakerHub LINX v2.0.0.93 by MakerHub**  
 Released On: Thu, 14 May 2015 15:36:00 -0500  
 Author: Sam Kristoff  
 Copyright: Copyright (c) 2015, MakerHub  
 License: BSD2  
 Compatible LabVIEW Versions: >= 2011.  
 Compatible OS Versions: ALL.  
 Repository Name: NI LabVIEW Tools Network

**Description:**  
 LINX provides easy to use VIs for interacting with common embedded platforms like Arduino, chipKIT and myRIO. Use the built in sensor VIs to start getting data to your PC in seconds or use the peripheral VIs to access your devices digital I/O, analog I/O, SPI, I2C, UART, PWM and more.

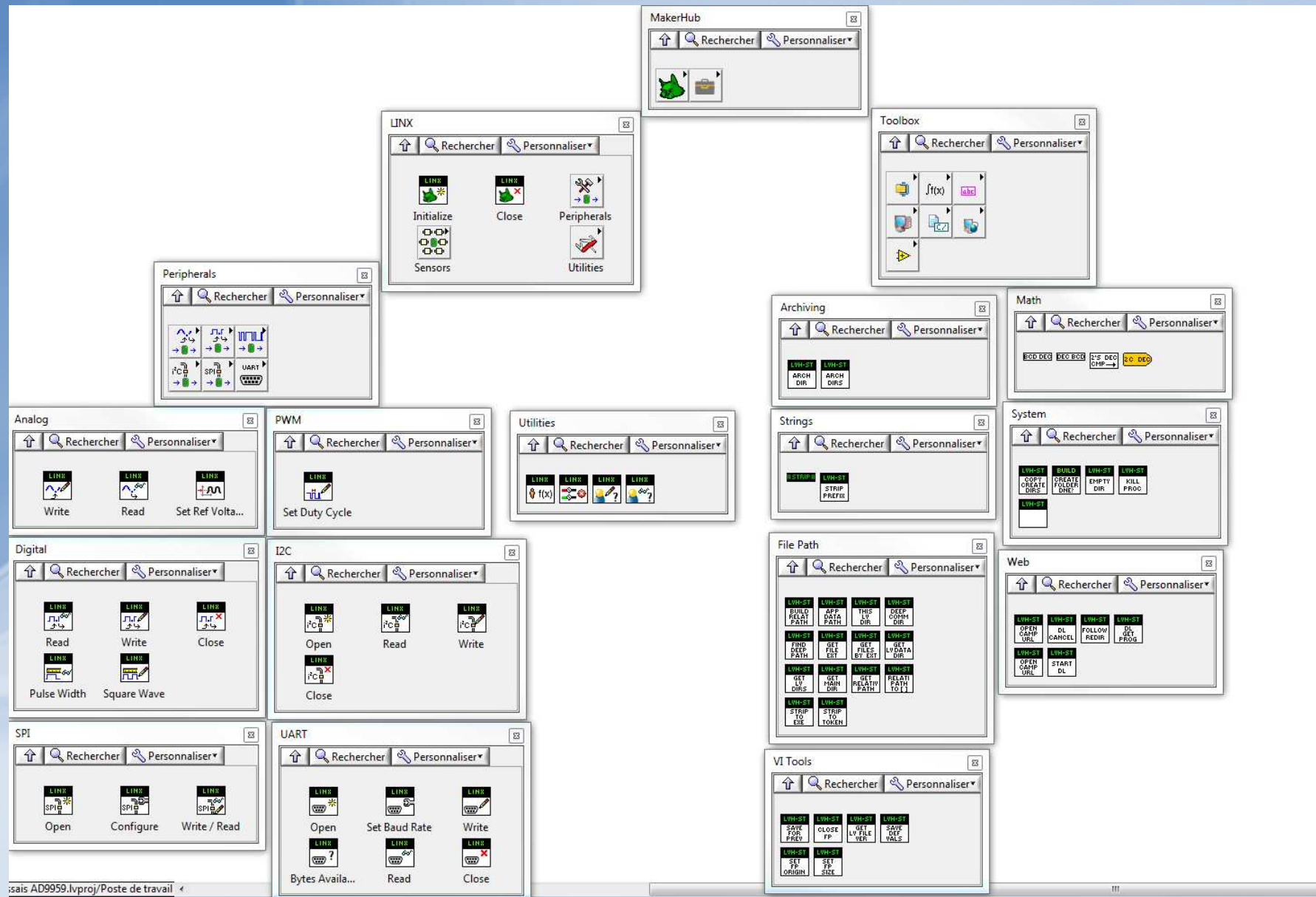
**Release Notes:**  
 Updated WF32 Firmware to boost LINX wifi throughput by ~25x  
 Changed the way the Leonardo and Pro Micro bootloaded is triggered to be more reliable.  
 Added support for WS2812 on chipKIT WF32 (support for more devices may be added later).

LINX 2.0  
 Firmware  
 -Completely re-written to enable more code re-use between devices.  
 -Object oriented firmware makes it easy to add new devices in an existing family.

**VPM Legend**  
 The package listed is not compatible with the selected LabVIEW version or operating system.  
 The package installed is missing dependencies or there is a dependency conflict.  
 The package installed is not the latest. There is a newer version available.  
 The package listed is installed in the current LabVIEW version.



# MakerHub - LINX



## Quelques références :

[https://wiki.electroniciens.cnrs.fr/index.php/Le\\_groupe\\_DDS](https://wiki.electroniciens.cnrs.fr/index.php/Le_groupe_DDS)

Fabrice Wiotte (LPL Paris 13)

Precision optical trapping via a programmable DDS-based controller for AODs

A.H. Mack, M.K. Trias, and S.G.J. Mochrie

Review of Scientific Instruments 80, 016101 (2009)

[http://ftp.aip.org/epaps/rev\\_sci\\_instrument/E-RSINAK-80-002901/ddsSupplem.pdf](http://ftp.aip.org/epaps/rev_sci_instrument/E-RSINAK-80-002901/ddsSupplem.pdf)

Seminaire : Practical Application of Direct Digital Synthesis (DDS) (2012)

Baltasar Pérez Diaz (Idetic, Las Palmas)

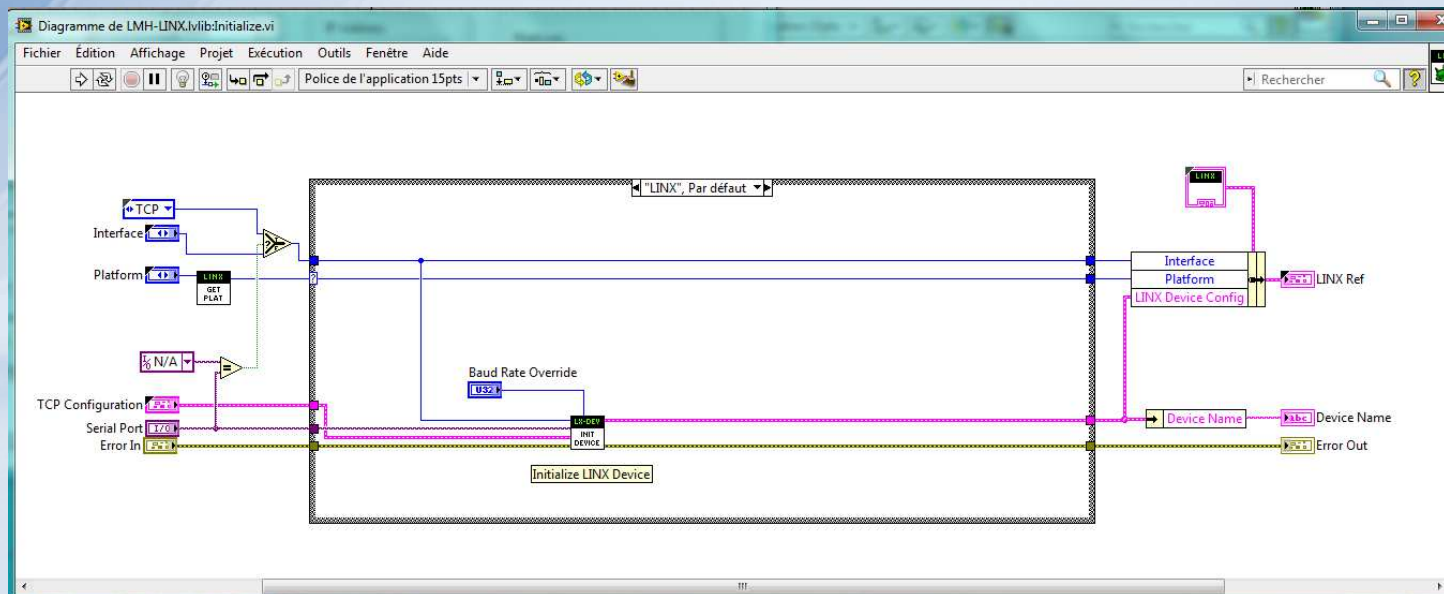
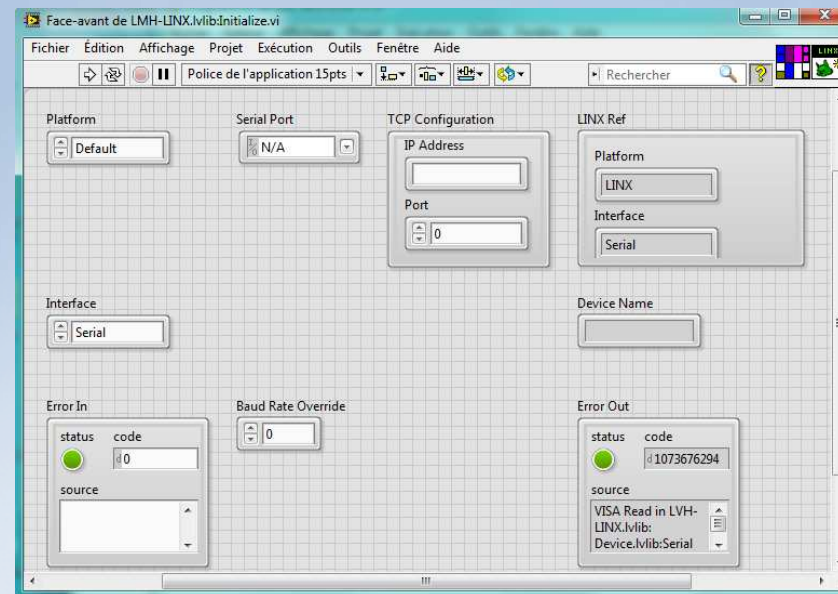
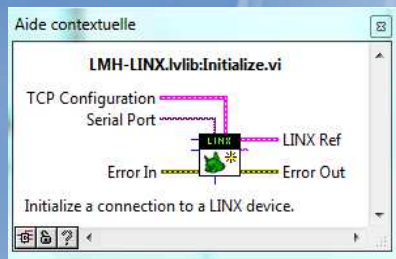
<https://ez.analog.com/community/dds>

[https://www.labviewmakerhub.com/doku.php?id=learn:tutorials:libraries:linx:getting\\_started&s\[\]=wizard](https://www.labviewmakerhub.com/doku.php?id=learn:tutorials:libraries:linx:getting_started&s[]=wizard)

<https://decibel.ni.com/content/groups/labview-interface-for-arduino>









### Amplificateur Mini-circuits ZHL-1-2W-S+ 1

- wideband 5 to 500 MHz
- high power output +33 dBm min.
- high gain +29 dB min.
- high IP3 +44 dBm typ.



### Oscillateur 25MHz Crystek



### Atténuateur Mini-circuits ZX73-2500-S+ 1

- Broadband, 10-2500 MHz
- IP3, +43 dBm typ.
- 40 dB attenuation @ 1500 MHz
- Good VSWR at in /out ports over attenuation range
- No external bias and RF matching network required

**Etat des straps le 17/08/2015 carte AD9959/evaluation board Z REV. C**  
**En utilisation standard (Soft Analog Devices)**

**PCS 1346 (S14-0831 SN 00007)**

W9 ON

W10 ON

W1 ON

W2 ON

W3 ON

W6 (RURD\_0) ON

W4 (RURD\_1) ON

W5 (RURD\_2) ON

W7 (PC\_CTRL) PC (not MANUAL)

W11 REF\_CLK (not CRYSTAL)

---

**Etat des straps le 18/08/2015**  
**En utilisation avec l'ARDUINO UNO**

W9 ON

W10 OUT

W1 OUT

W2 OUT

W3 OUT

W6 (RURD\_0) OUT

W4 (RURD\_1) OUT

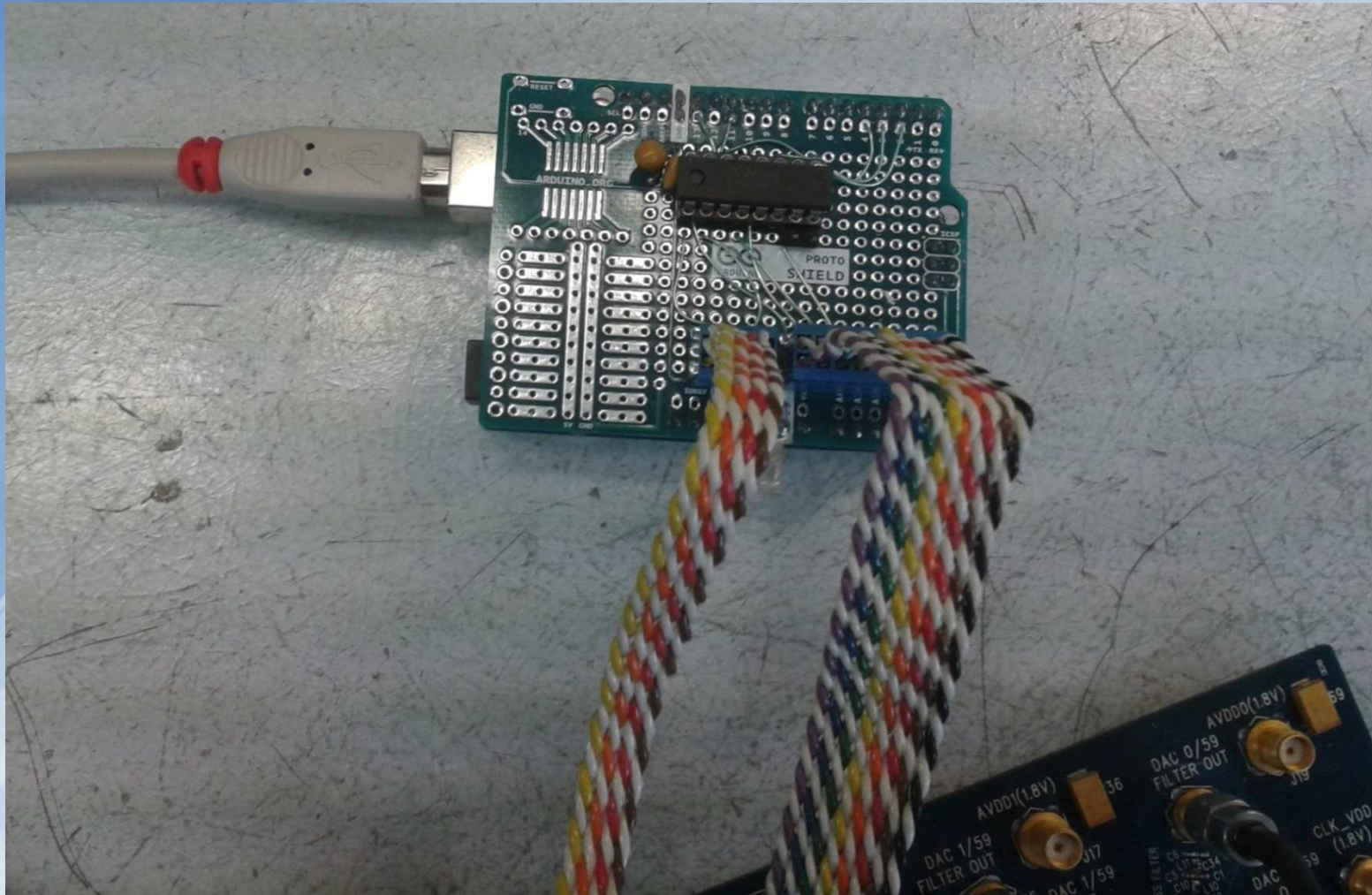
W5 (RURD\_2) OUT

W7 (PC\_CTRL) **MANUAL** (not PC)

W11 **REF\_CLK** (not CRYSTAL)



## interface sur carte shield



## FUNCTIONAL BLOCK DIAGRAM

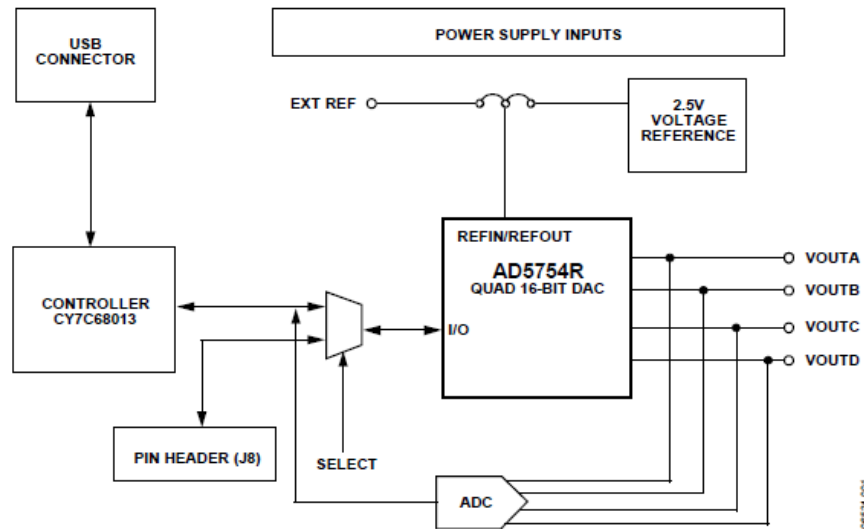
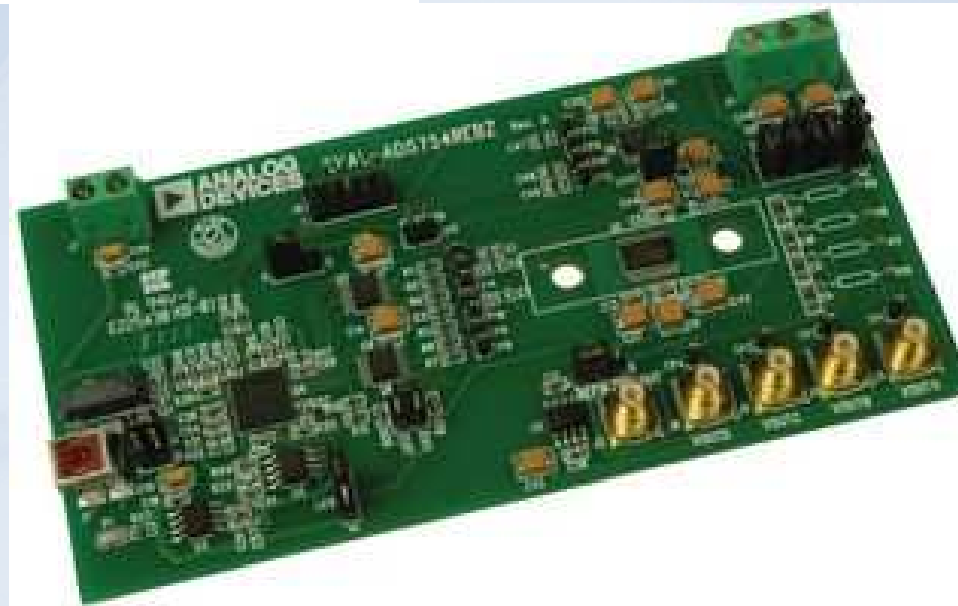
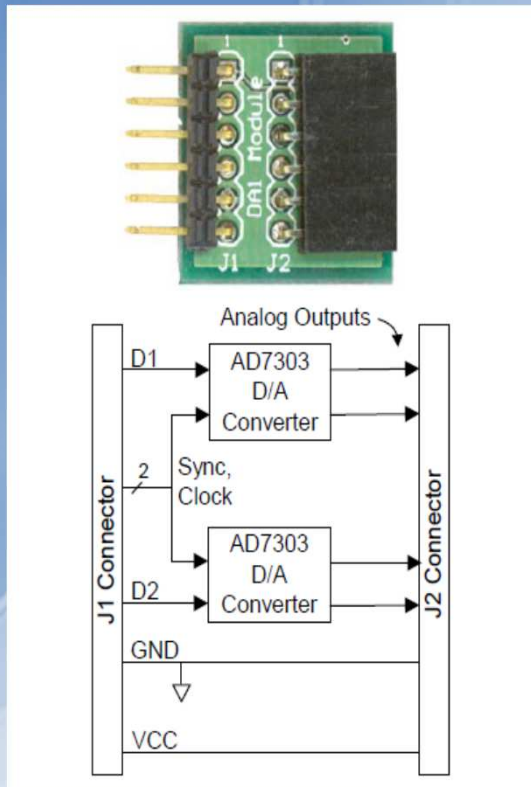


Figure 1.

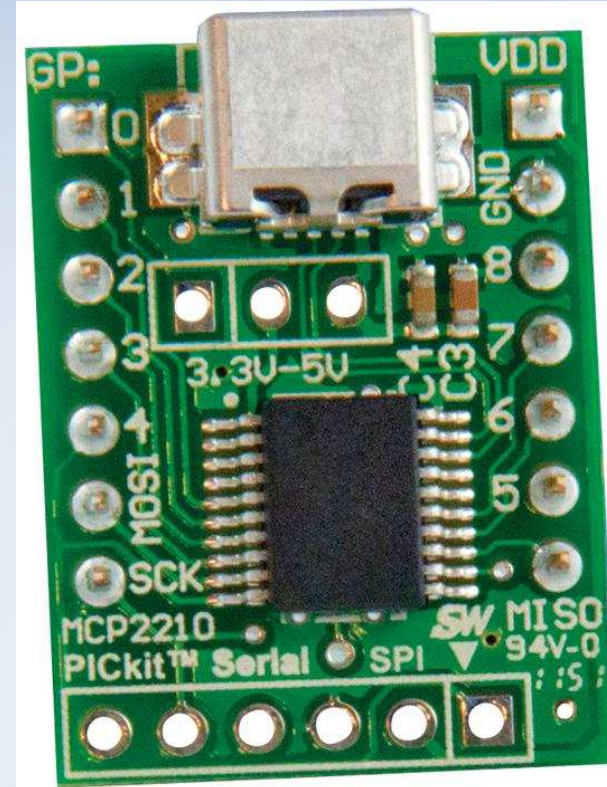
00334-001

AD5754





**PmodDA1**



**MCP2210**



**Arduino™ Compatible Compiler for LabVIEW –  
Aledyne-TSXperts**

***Compiler et télécharger les VIs LabVIEW sur les cibles Arduino***

- Connexion aux E/S et cartes d'interface Arduino™ grâce à des palettes personnalisées
- Tirer parti du prêt à l'emploi - il suffit de sélectionner un VI et de le télécharger
- Programmer des systèmes embarqués simples avec une programmation graphique



