Lecoeur Electronique – *300, Chemin des Comtois - 45220 CHUELLES* - Tel. : +33 (0)2 38 94 28 30 - Fax : +33 (0)2 38 94 29 67

US-ARRAY

Programming user guide

(Win dll, matlab, labview)

V1.0

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Init_USB

Description :

Initialise the USB3 link

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

Init_USB(Device_Number.l)

Device_Number.l : set the number of usb device (0 for one us-array)

With Matlab

Declaration :

loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');

Calling the function :

[Retour] = calllib('MyDLL','Init_USB',Device_Number);end

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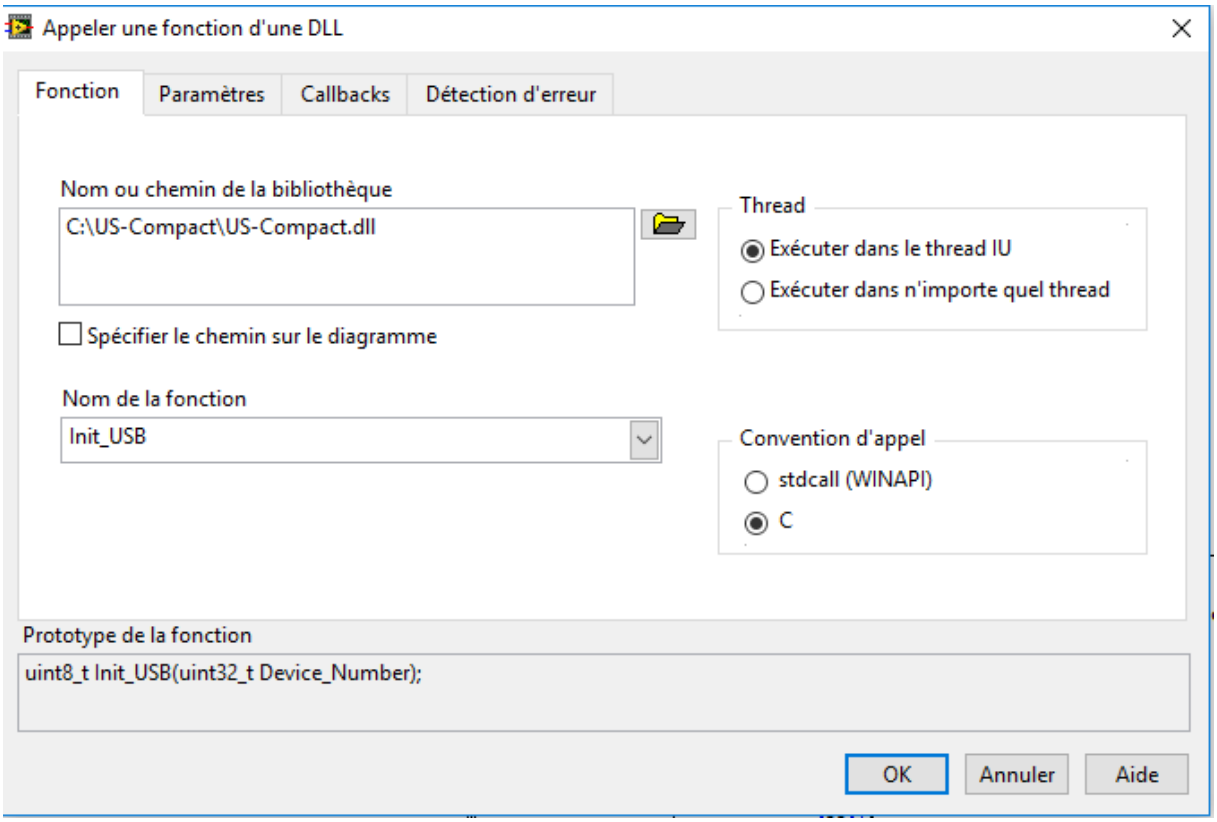
With Labview



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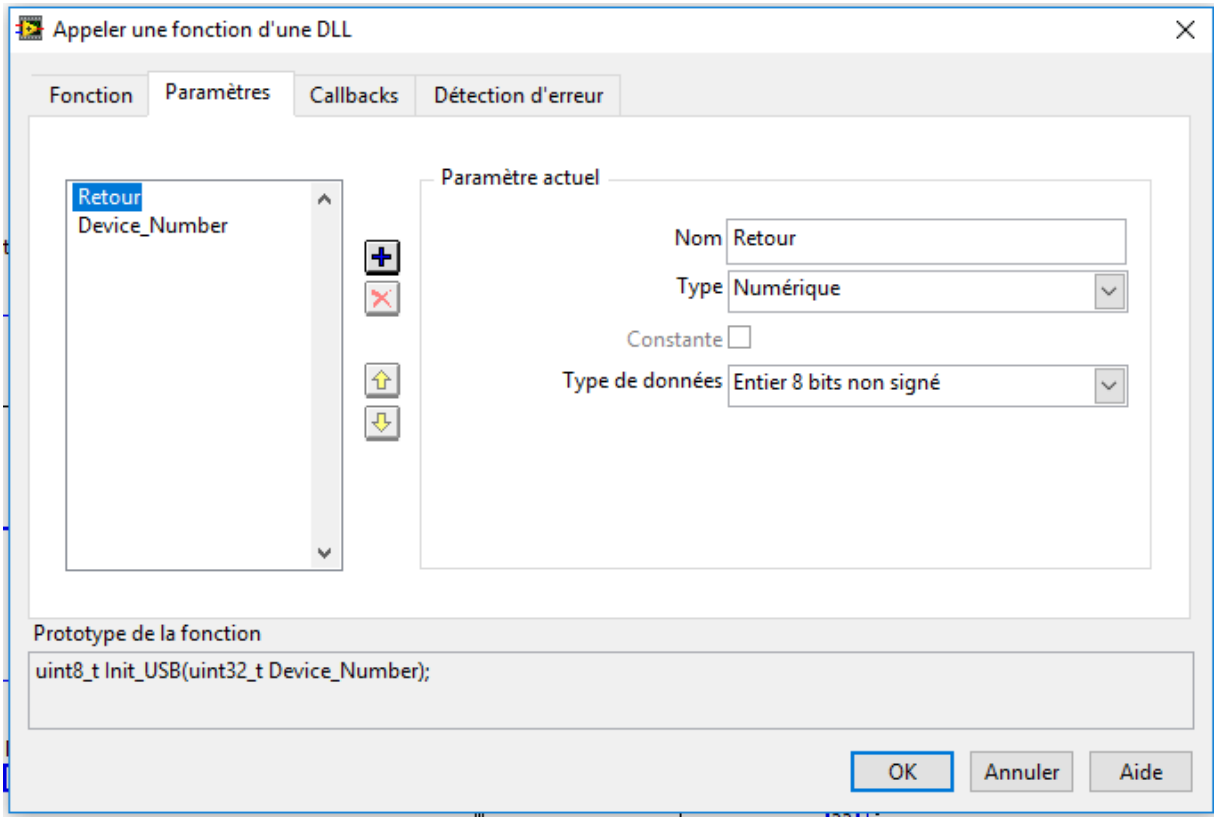

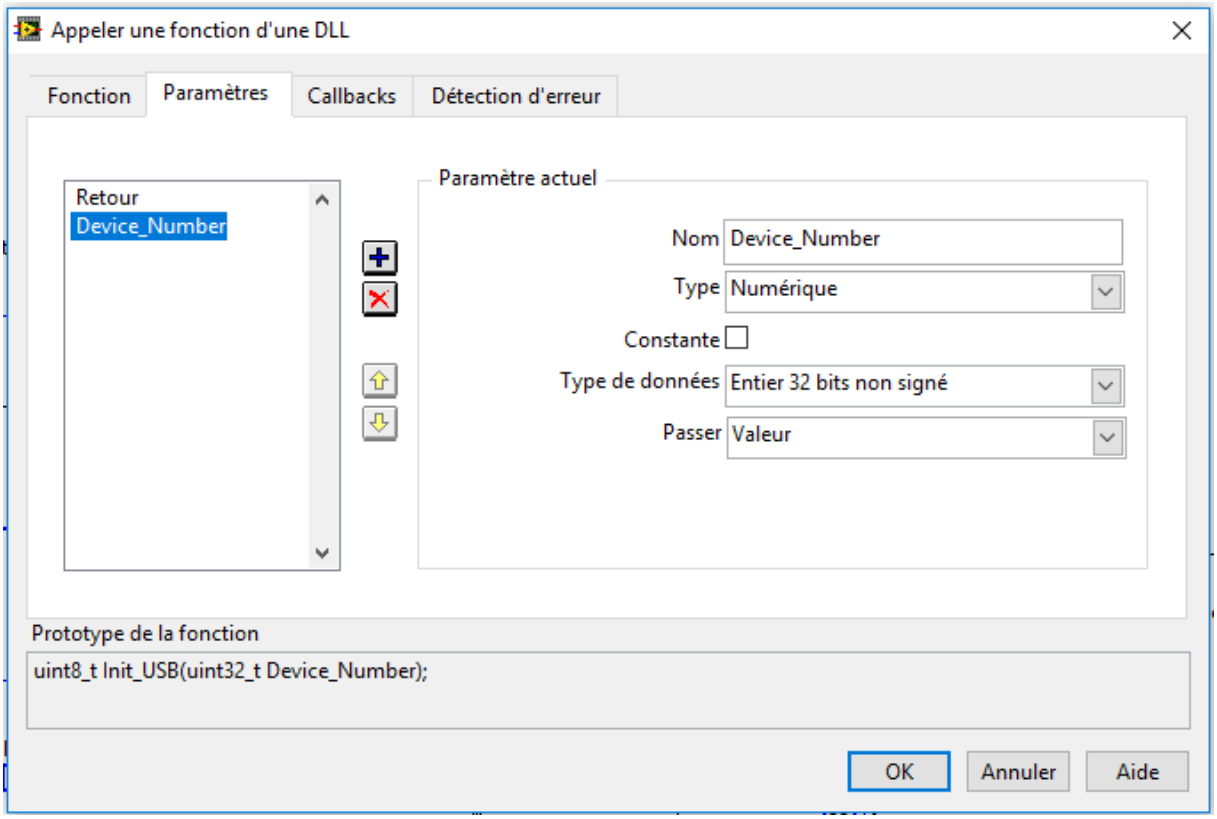

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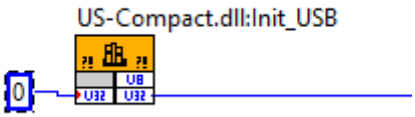

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Open_USB

Description :

Open the USB3 link

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

Open_USB(Device_Number.l)

Device_Number.l : set the number of usb device (0 for one us-array)

With Matlab

Declaration :

loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');

Calling the function :

[Retour] = calllib('MyDLL','Open_USB',Device_Number);end

With Labview

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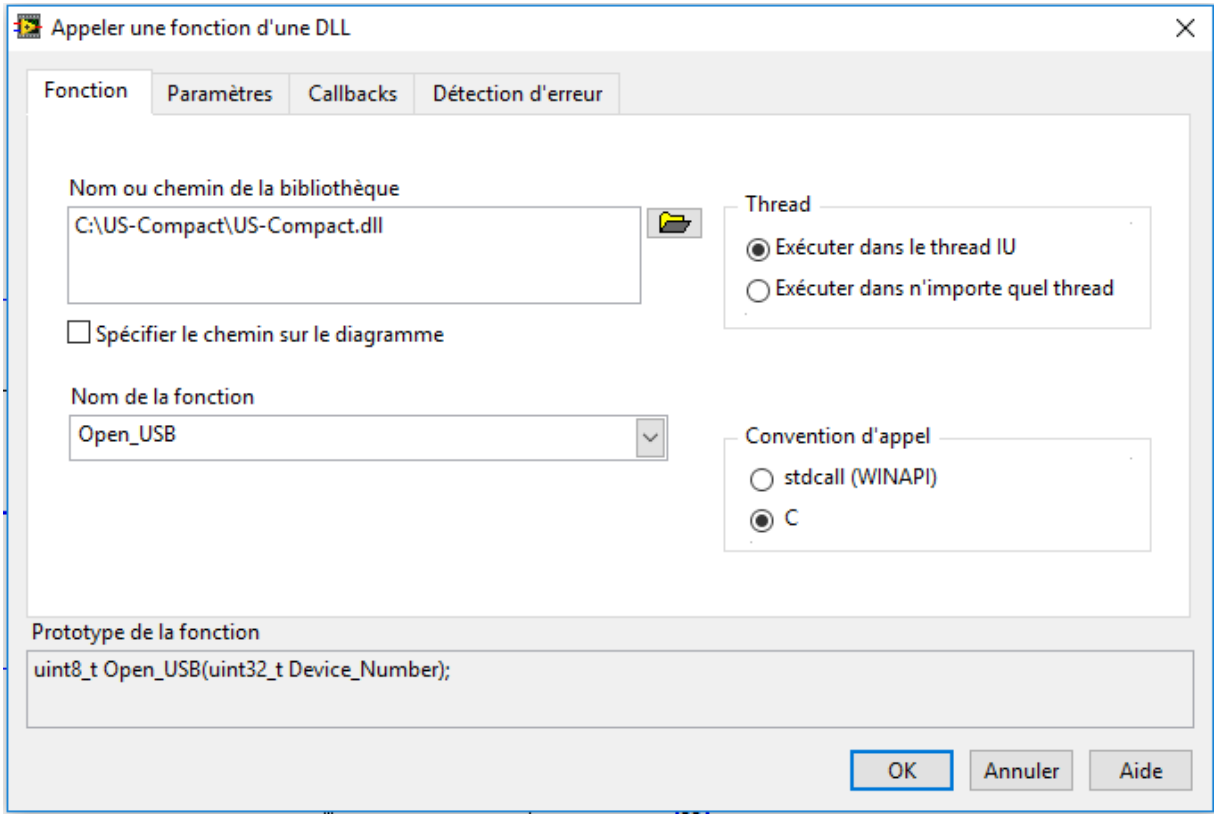

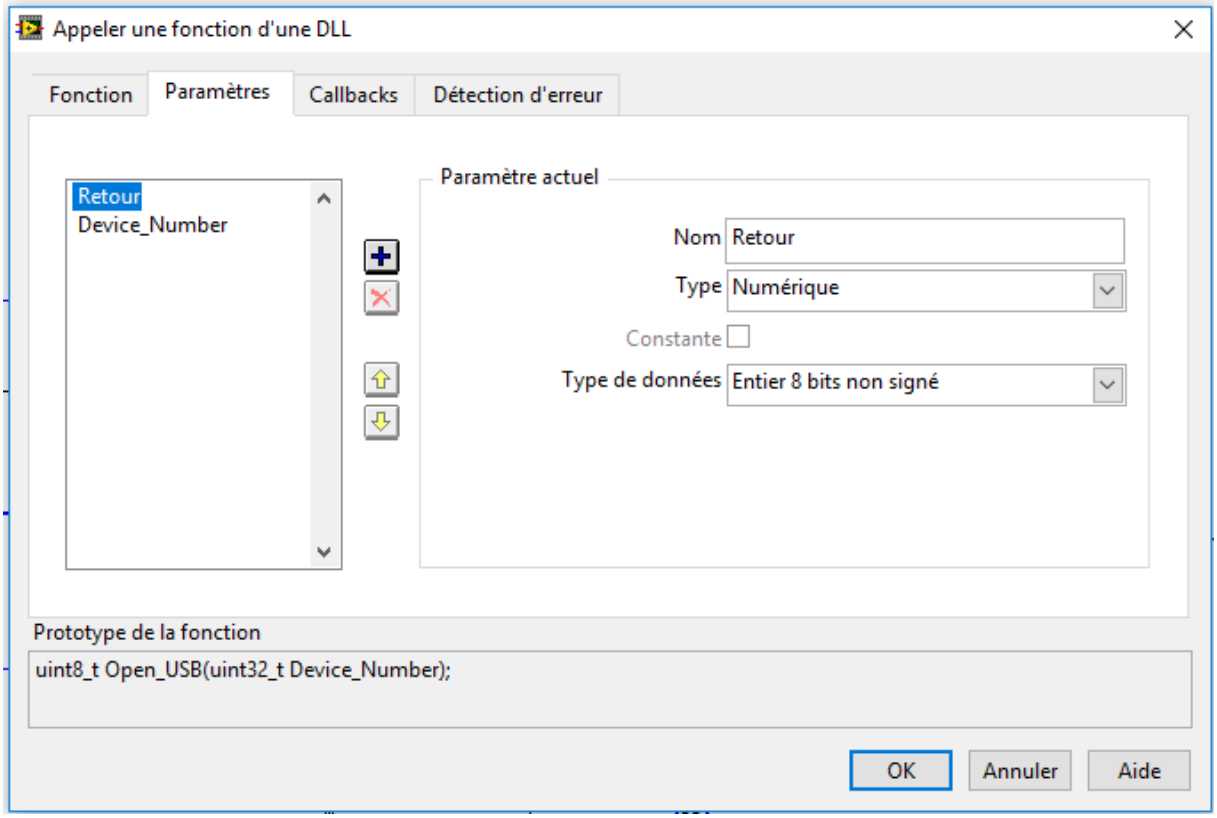

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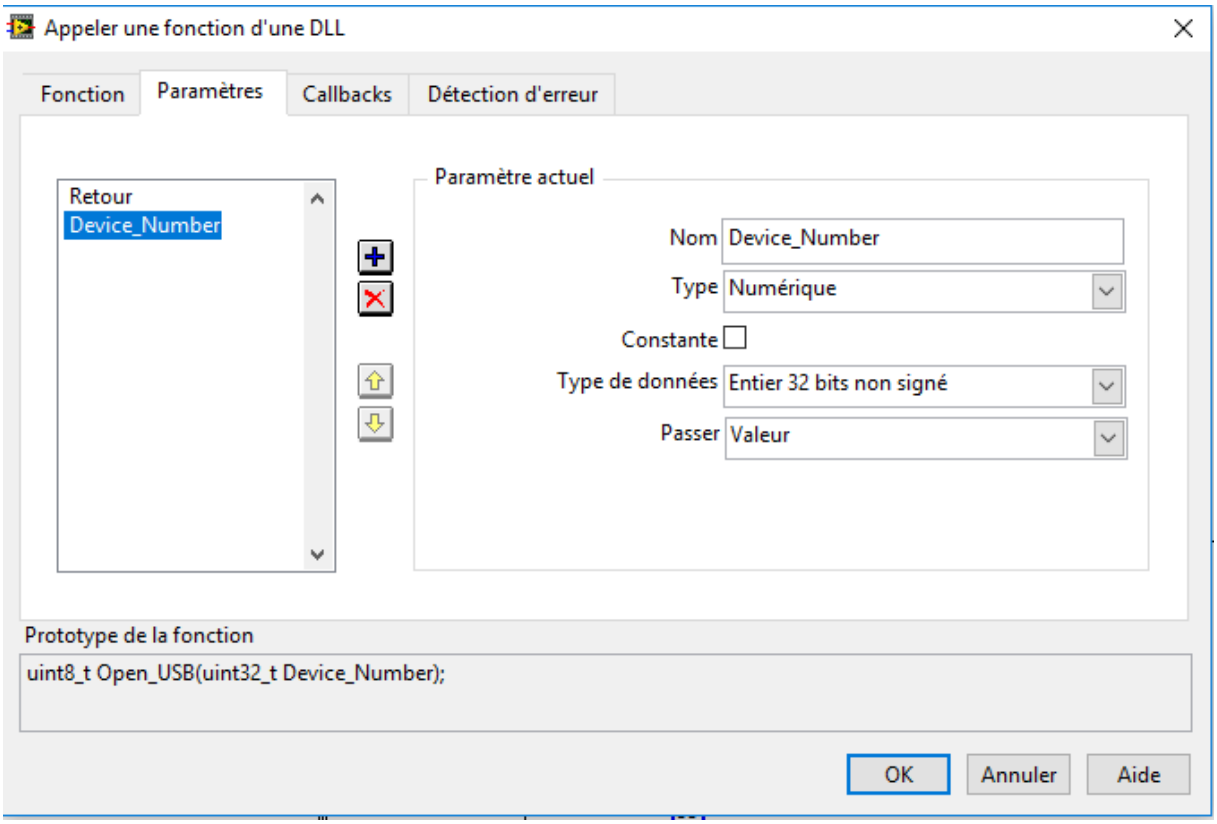

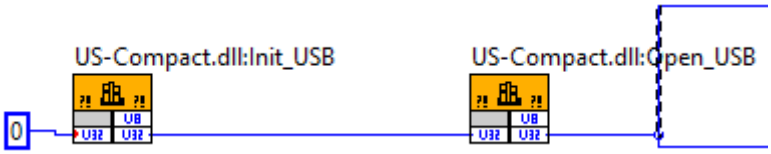

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Close_USB

Description :

Close the USB3 link

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

Close_USB()

Device_Number.l : set the number of usb device (0 for one us-array)

With Matlab

Declaration :

loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');

Calling the function :

[Retour] = calllib('MyDLL','Close_USB');end

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Init_Device

Description :

Initialise the USB3 link

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

Init_Device(Device_Number.l)

Device_Number.l : set the number of usb device (0 for one us-array)

With Matlab

Declaration :

loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');

Calling the function :

[Retour] = calllib('MyDLL',Init_Device',Device_Number);end

With Labview

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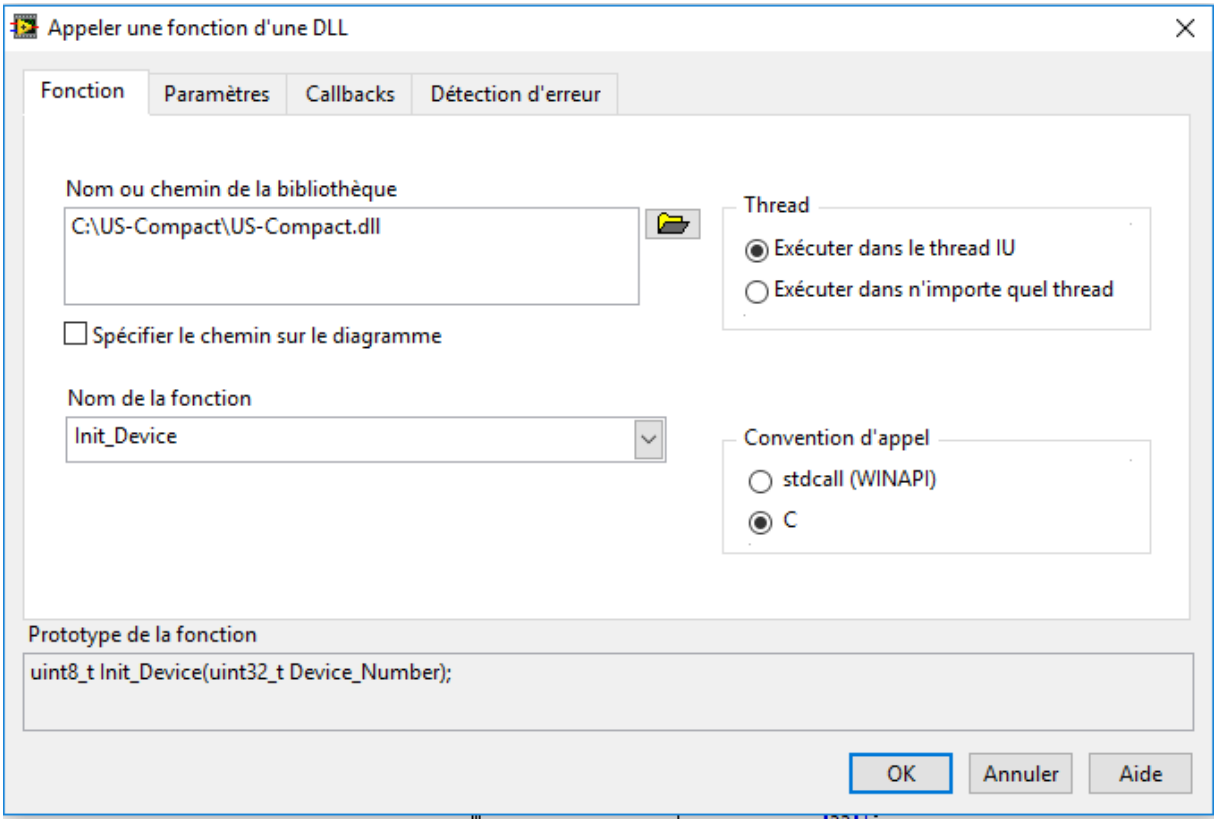

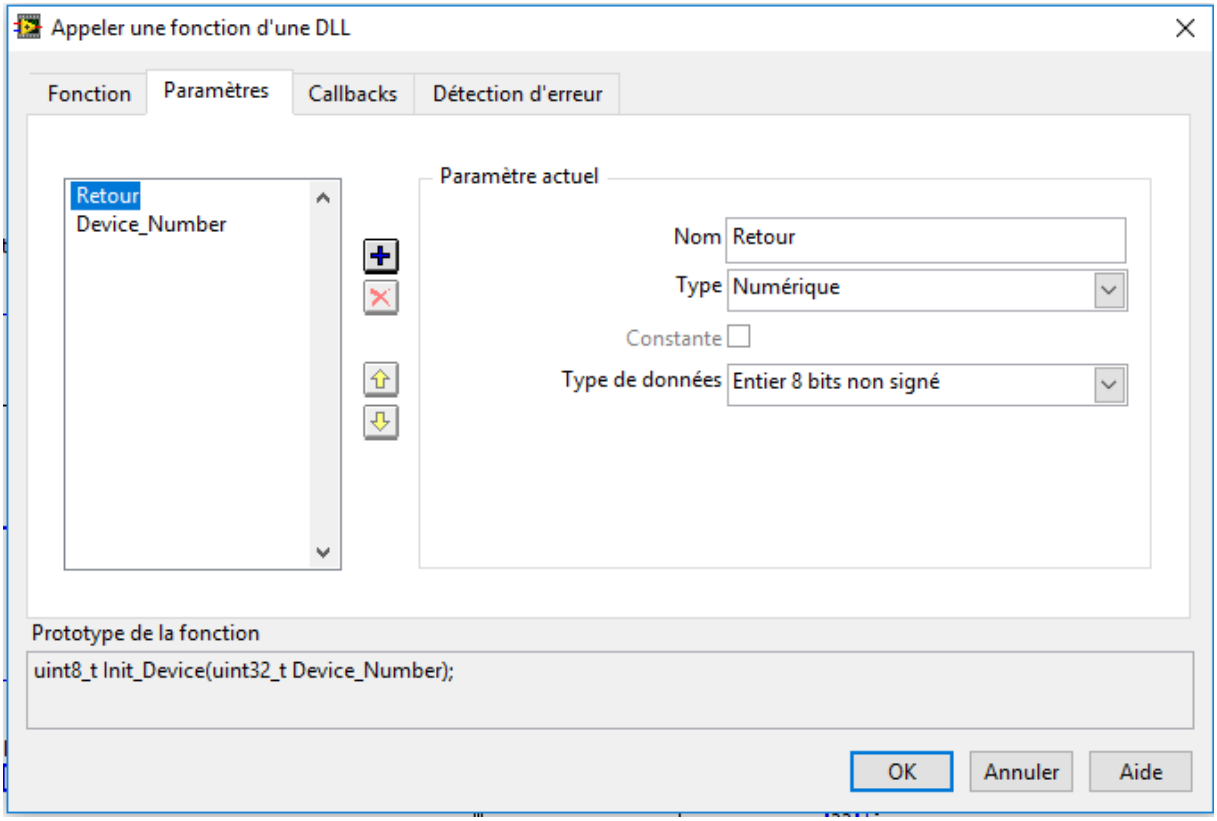

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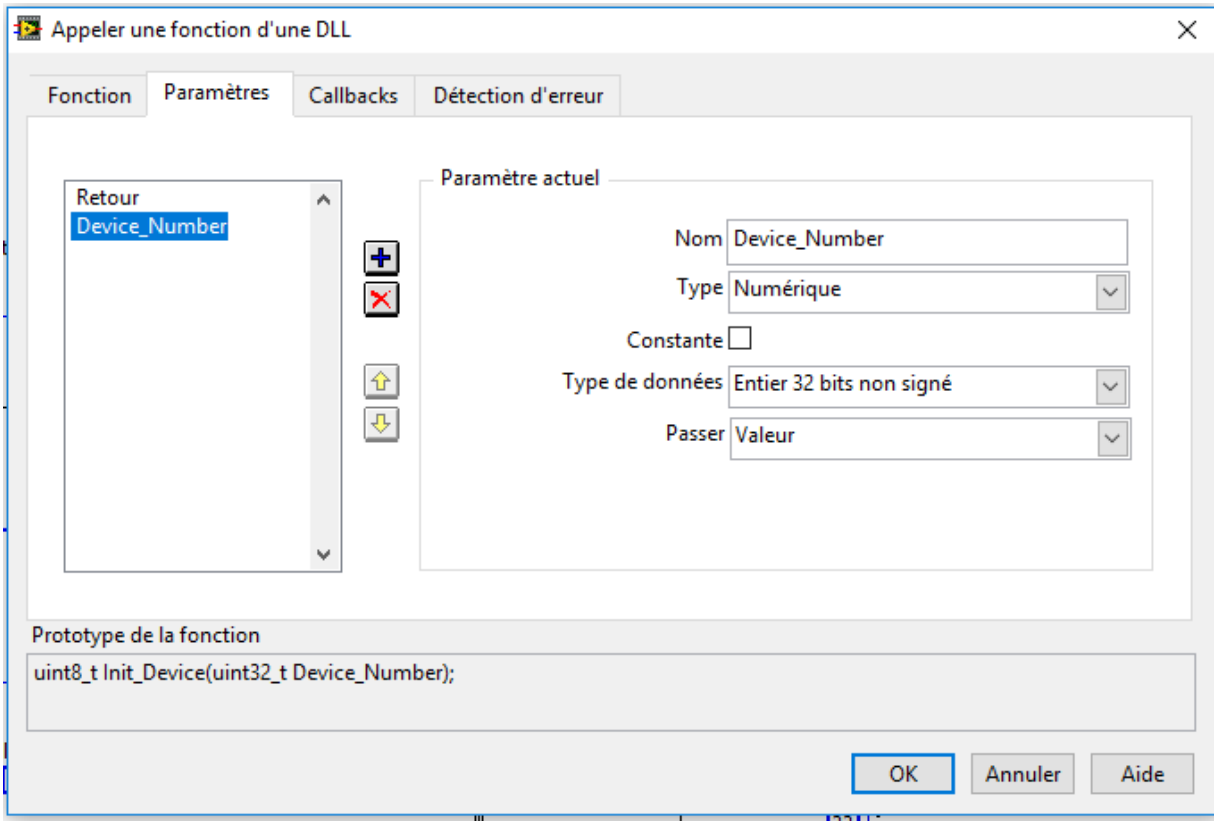

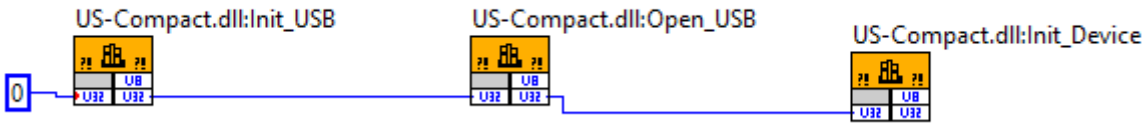

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GAIN

Description :

Set the amplifiers gains to a selected value. Up to 128 values per channel can be programmed to fit with the 128 sequences.

Features :

Range : 0 to 80 dB

Step : 0.1 dB

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

*Gain(Device_Number.l,Channel.a,*Tab_In)*

Device_Number.l : set the number of usb device (0 for one us-array)

Channel.a : set the channel number (1 to 32)

Tab In : A table filled with a maximum of 128 gain values corresponding to the 128 sequences. Each gain value is a 32 bits Float.

With Matlab

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Declaration :

```
loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');
```

Calling the function :

```
for j=1:64
   Tab_Gain(j) = 20;    % Gain by sequence
end
for i=1:32
   Channel = i-1;          % Channel selection
 [Retour] = calllib('MyDLL','Gain',Device_Number,Channel,Tab_Gain);
end
```

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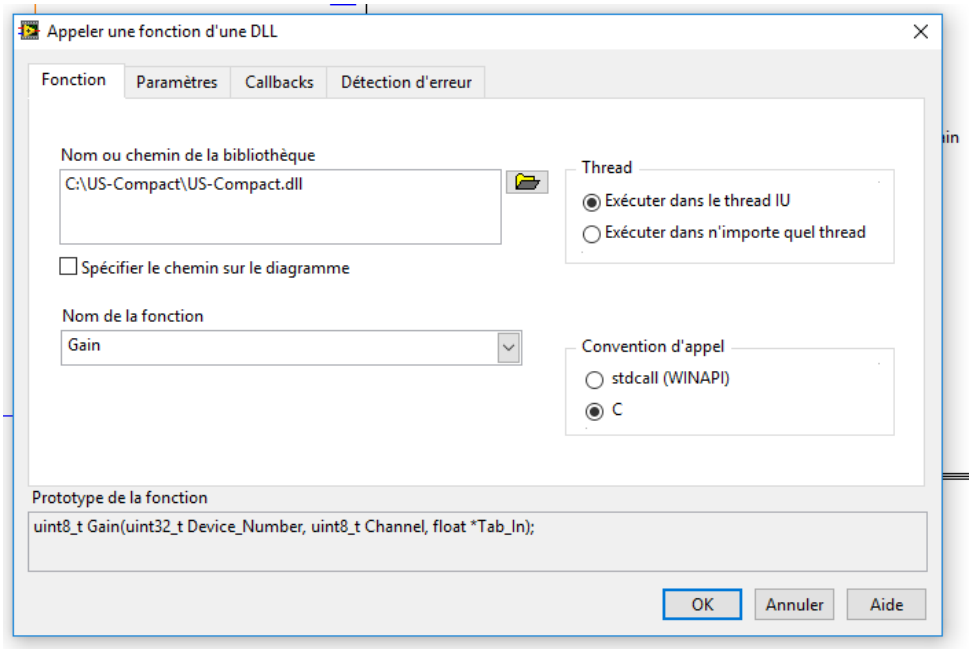
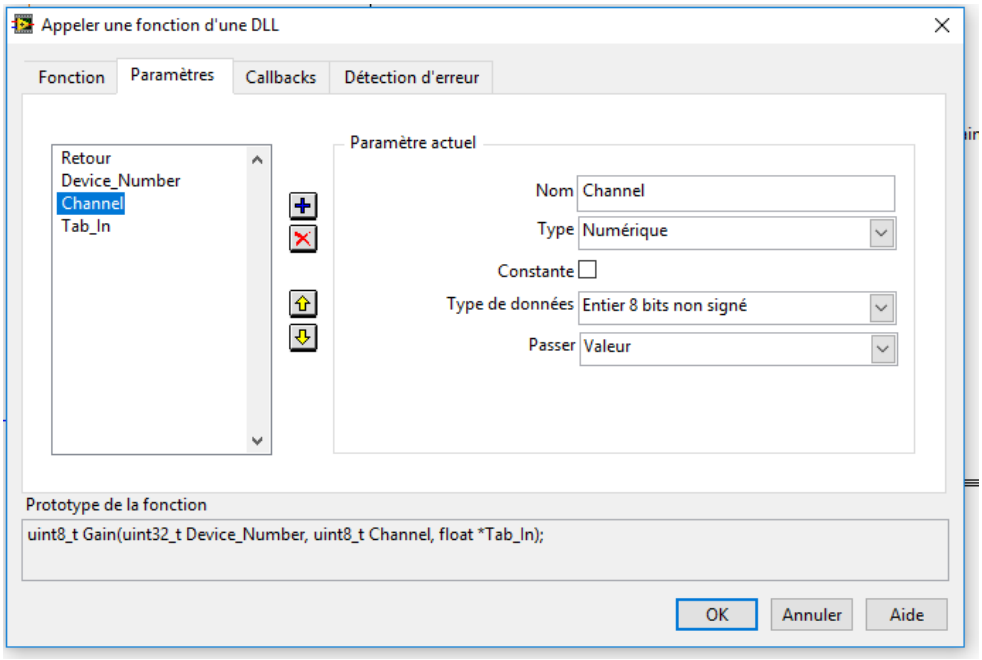
With Labview





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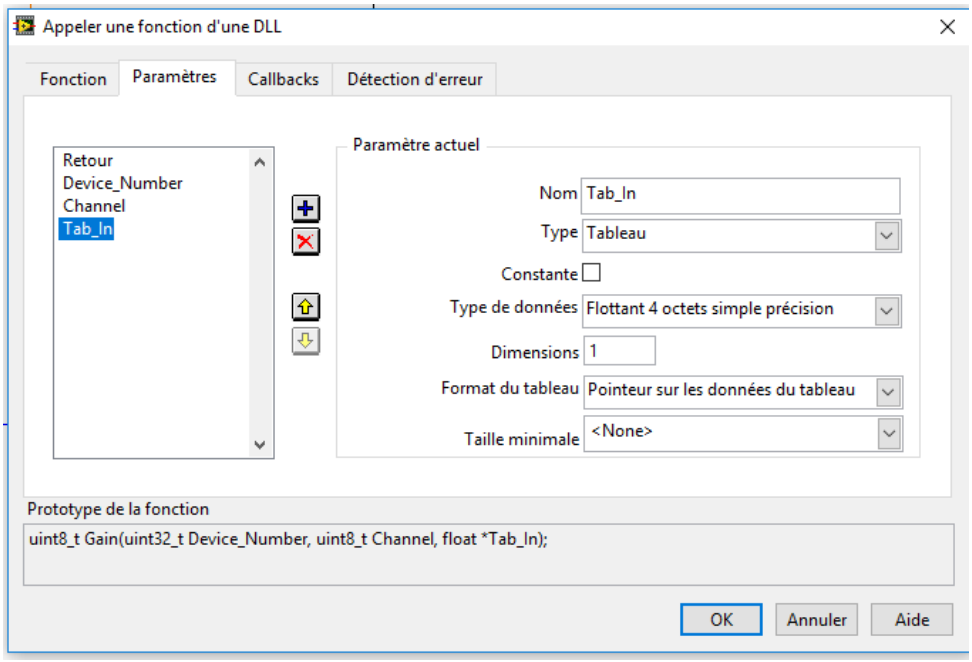

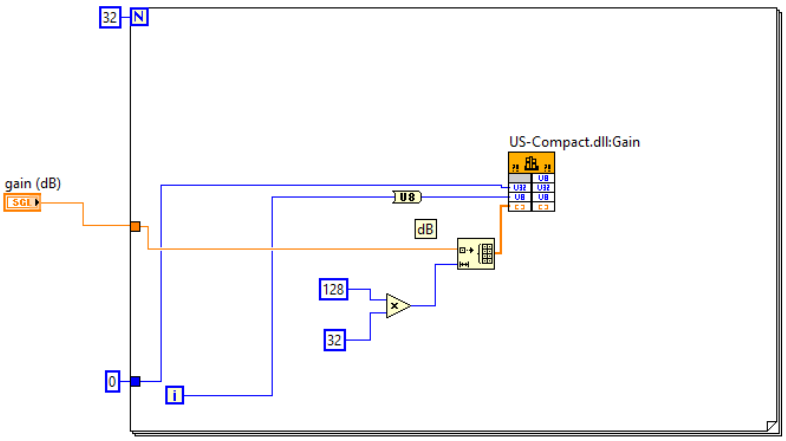

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Sampling_Delay

Description :

Set a constant delay on all receivers. The value is apply for all the sequences at the same value.

Features :

Range : 0 to 800 µS

Step : 0.0125 µS

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

Sampling_Delay(Device_Number.l,Delay.u)

Device_Number.l : set the number of usb device (0 for one us-array)

Delay.u : value from 0 to 65535, (delay= 0.0125 * Delay.u). Value is unsigned 16

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With Matlab

Declaration :

```
loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');
```

Calling the function :

```
Sampling_Delay = 0;          % Global scanning delay (80 MHz step value)

[Retour] = calllib('MyDLL','Sampling_Delay',Device_Number,Sampling_Delay);
```

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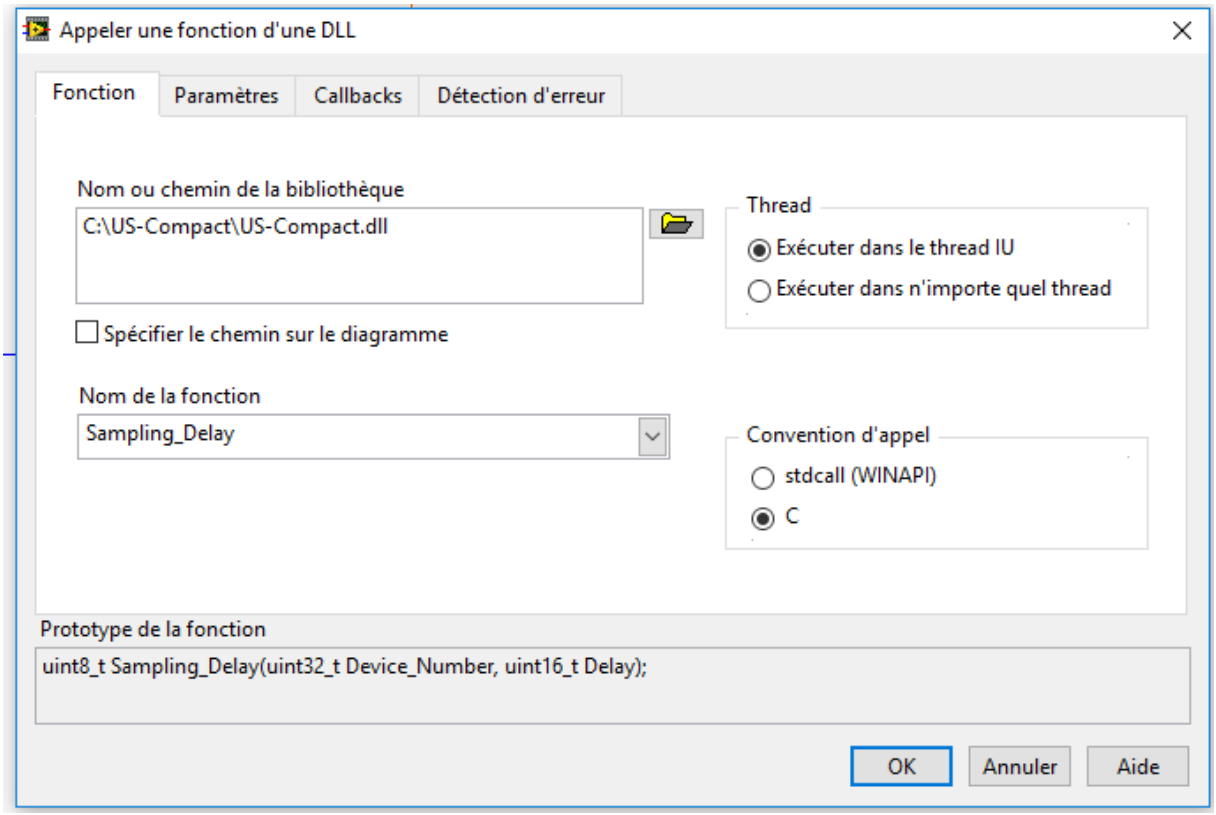
With Labview



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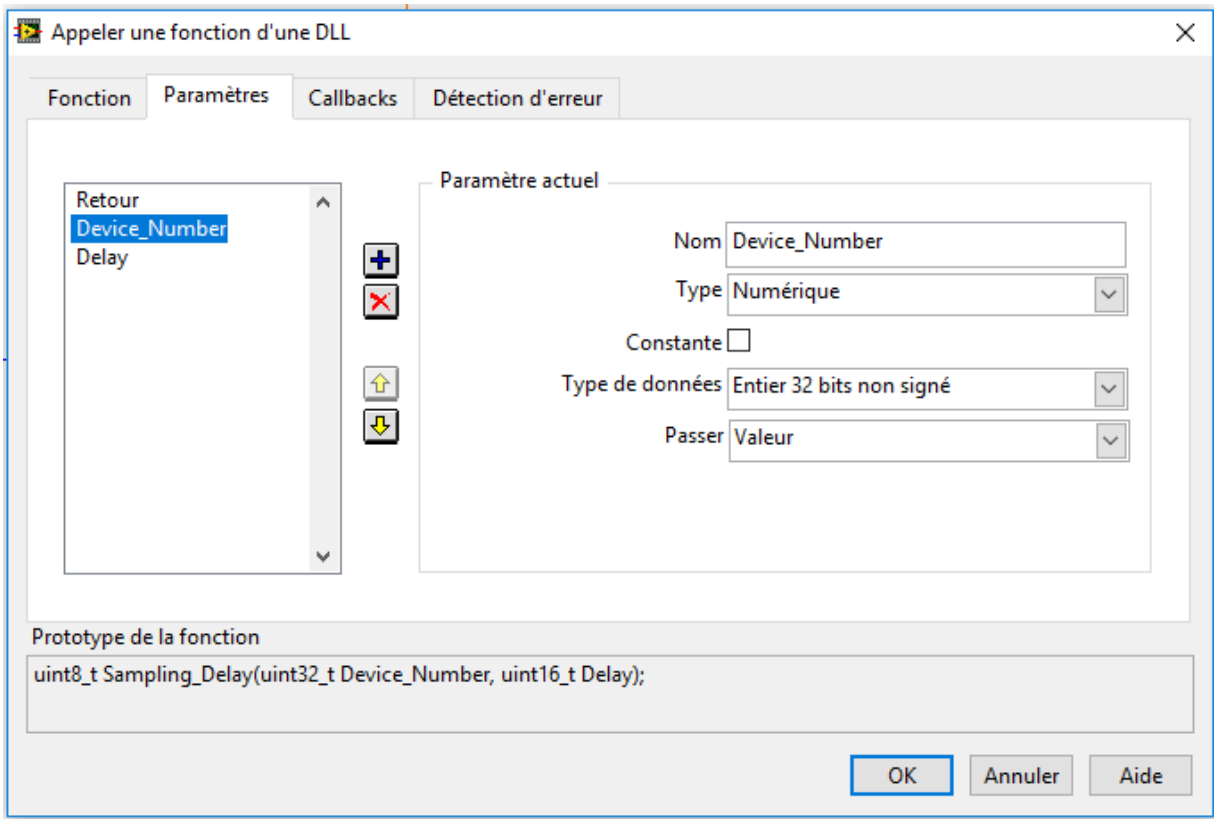

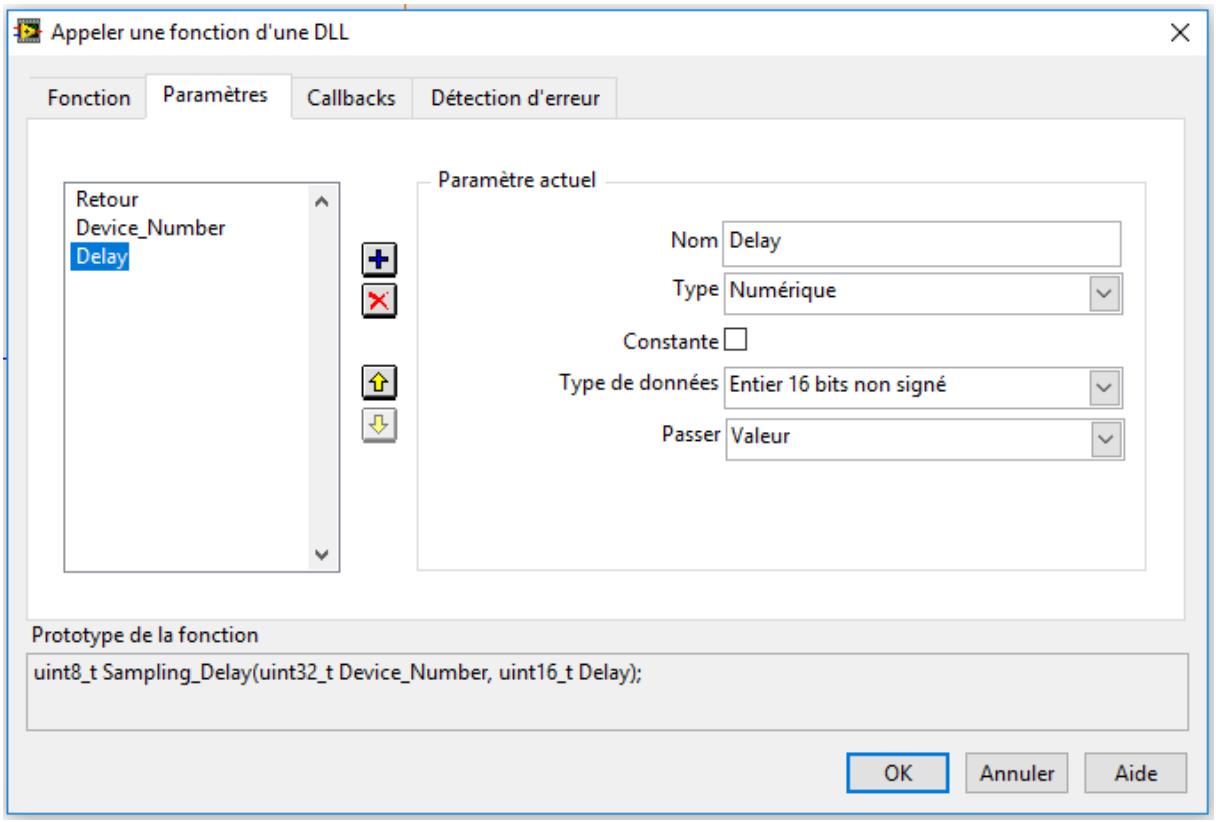

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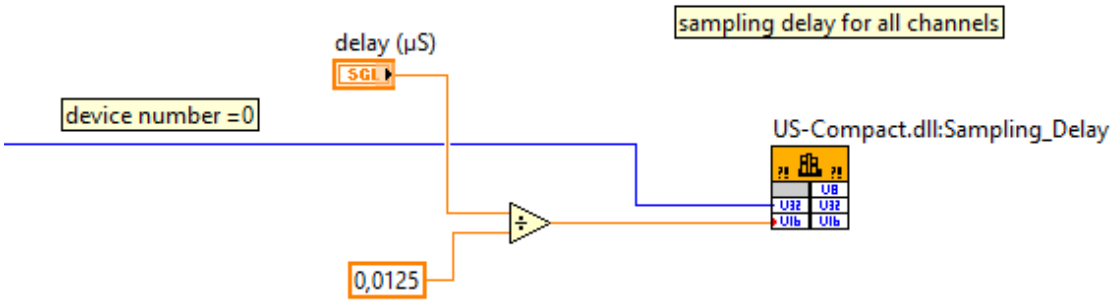

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Receiver_Delays

Description :

Set receivers delays for focusing. A table containing up to 128 values is sent on each channel. First value will be used for sequence 1, second value for sequence 2,…… to 128 sequences max.

Features :

Range : 0 to 800 µS

Step : 0.0125 µS

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

*Receiver_Delays(Device_Number.l,Channel.a,*Tab_In)*

Device_Number.l : set the number of usb device (0 for one us-array)

Channel.a : set the channel number (1 to 32)

*Tab_In : Table of delays for all sequences. Each value is unsigned 16.

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With Matlab

Declaration :

```
loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');
```

Calling the function :

```
for i=1:32
 Channel = i-1;                 %Channel selection
Tab_In(1) = 0;                  % Reception delay value for sequence No. 0 (step value = 80 MHz)
 [Retour] = calllib('MyDLL','Receiver_Delays',Device_Number,Channel,Tab_In);
end
```

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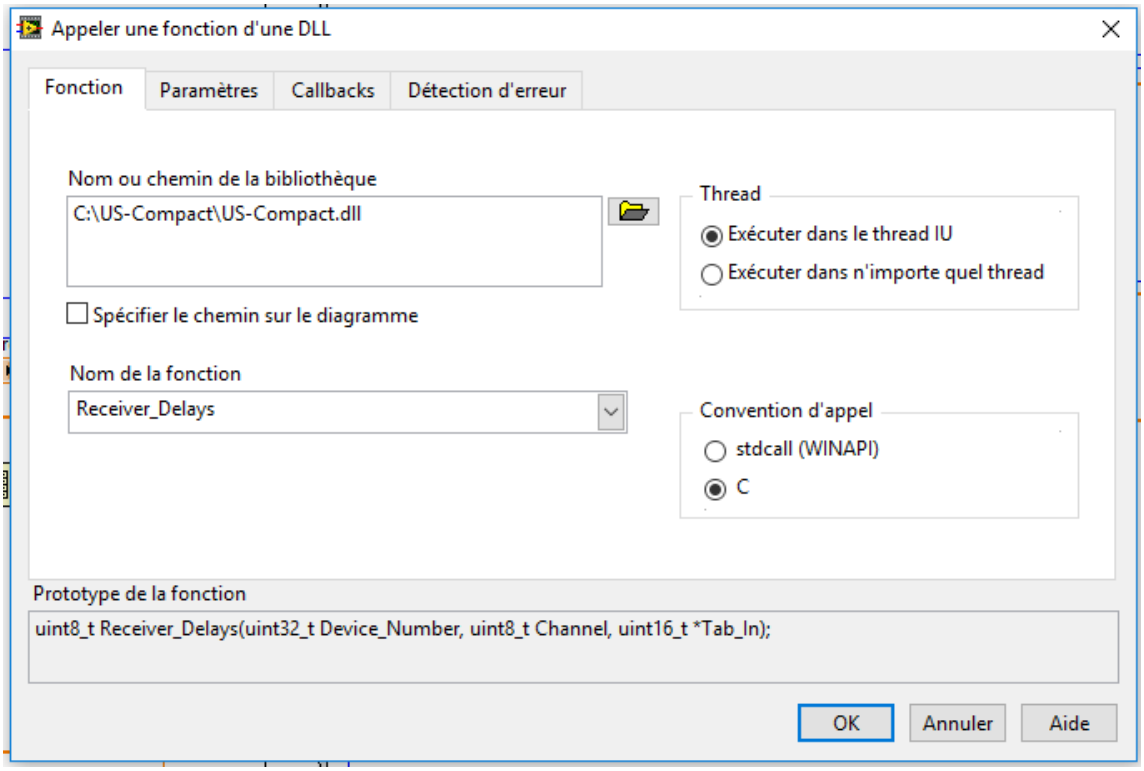
With Labview



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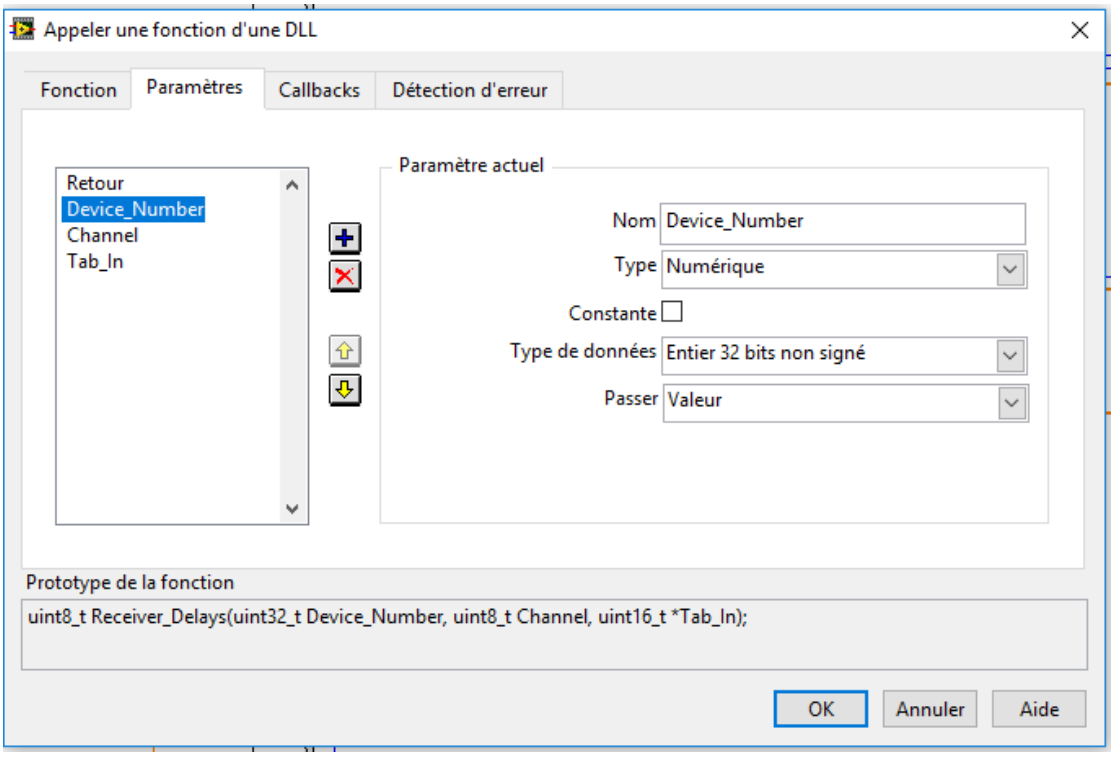

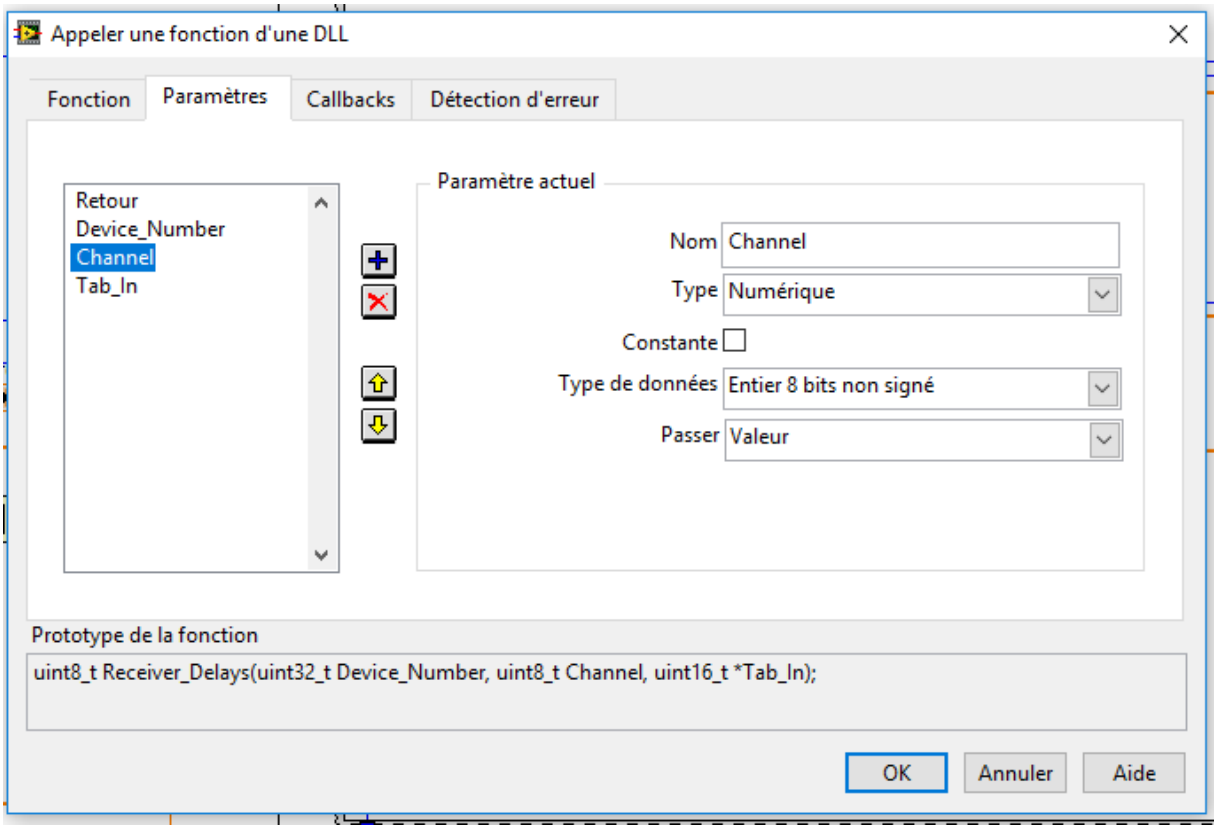

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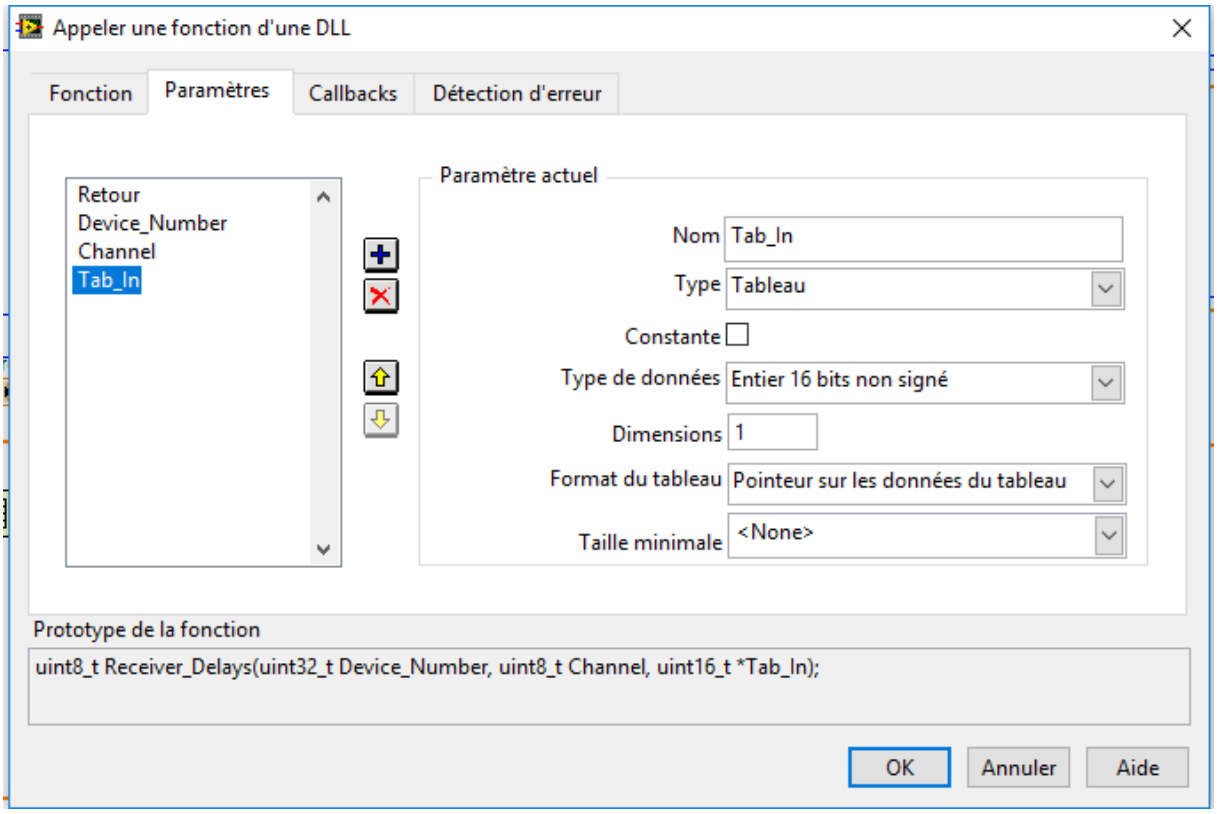

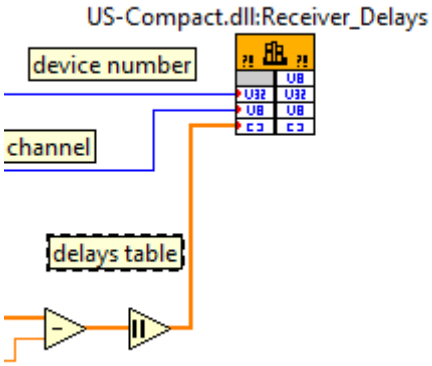

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Transmitter_Delays

Description :

Set transmitters delays for focusing. A table containing up to 128 values is sent on each channel. First value will be used for sequence 1, second value for sequence 2,…… to 128 sequences max.

Features :

Range : 0 to 800 µS

Step : 0.0125 µS

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

*Transmittter_Delays(Device_Number.l,Channel.a,*Tab_In)*

Device_Number.l : set the number of usb device (0 for one us-array)

Channel.a : set the channel number (1 to 32)

*Tab_In : Table of delays for all sequences. Each value is unsigned 16.

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With Matlab

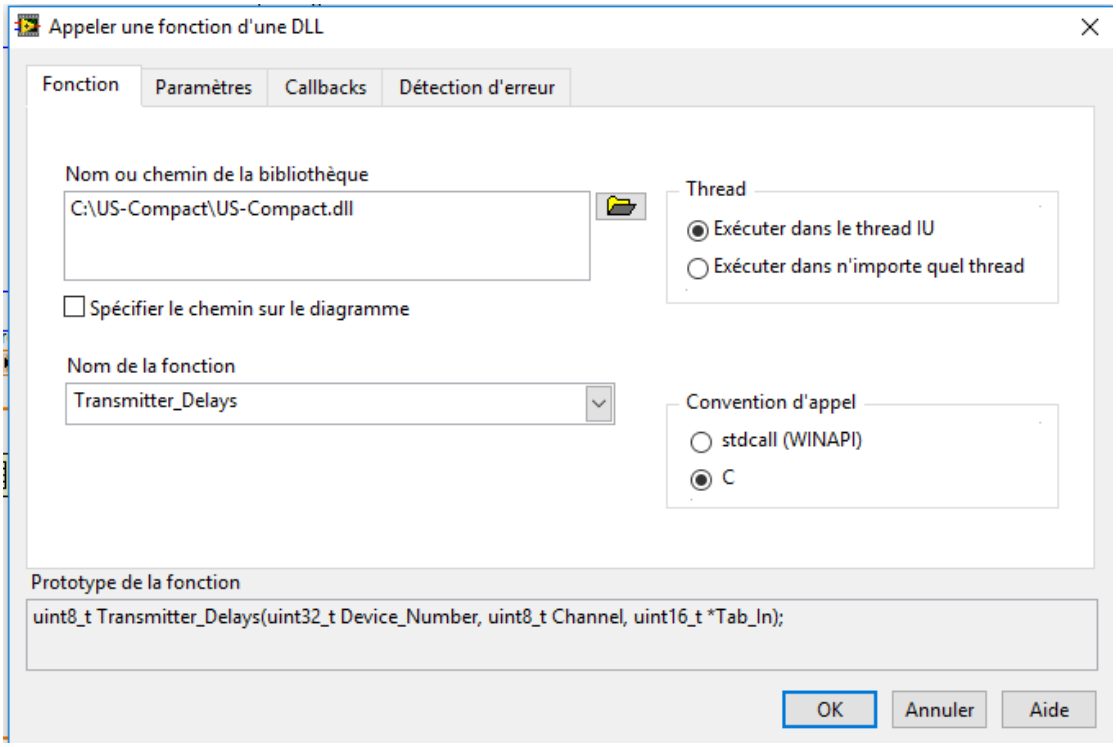
Declaration :

```
loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');
```

Calling the function :

```
for i=1:32
 Channel = i-1;                 %Channel selection
Tab_In(1) = 0;                  % Transmitter delay value for sequence No. 0 (step value = 80 MHz)
 [Retour] = calllib('MyDLL','Transmitter_Delays',Device_Number,Channel,Tab_In);
end
```

With Labview



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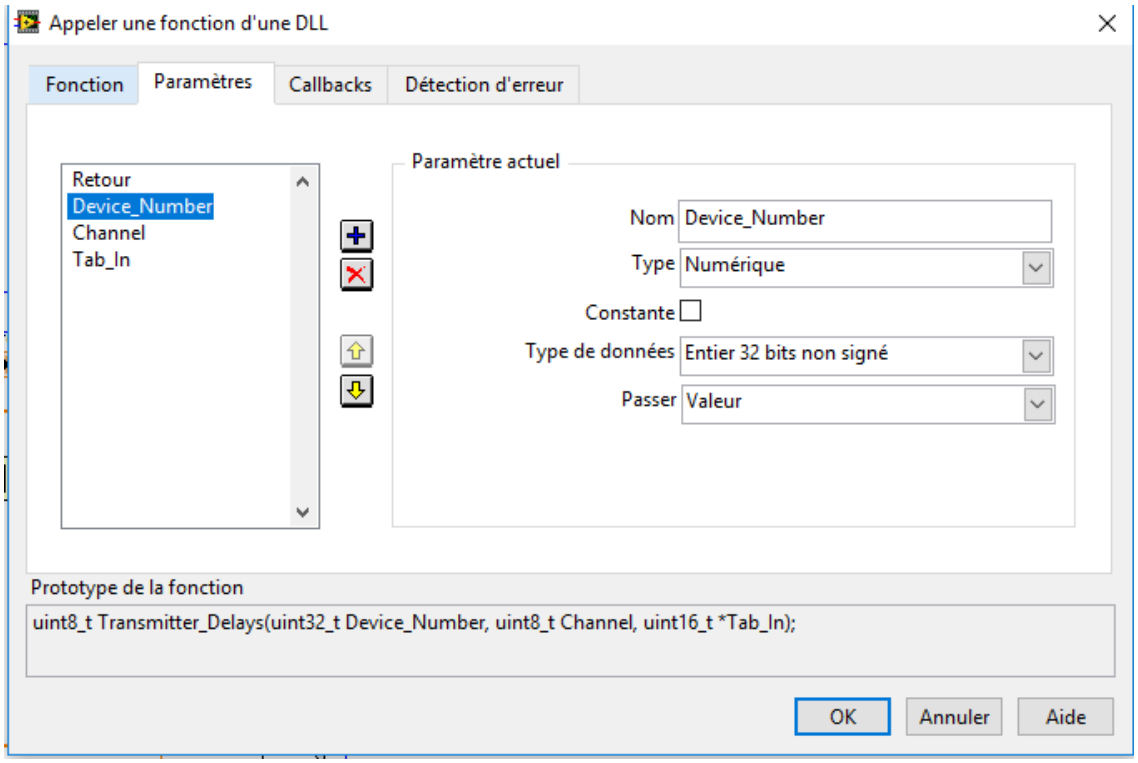

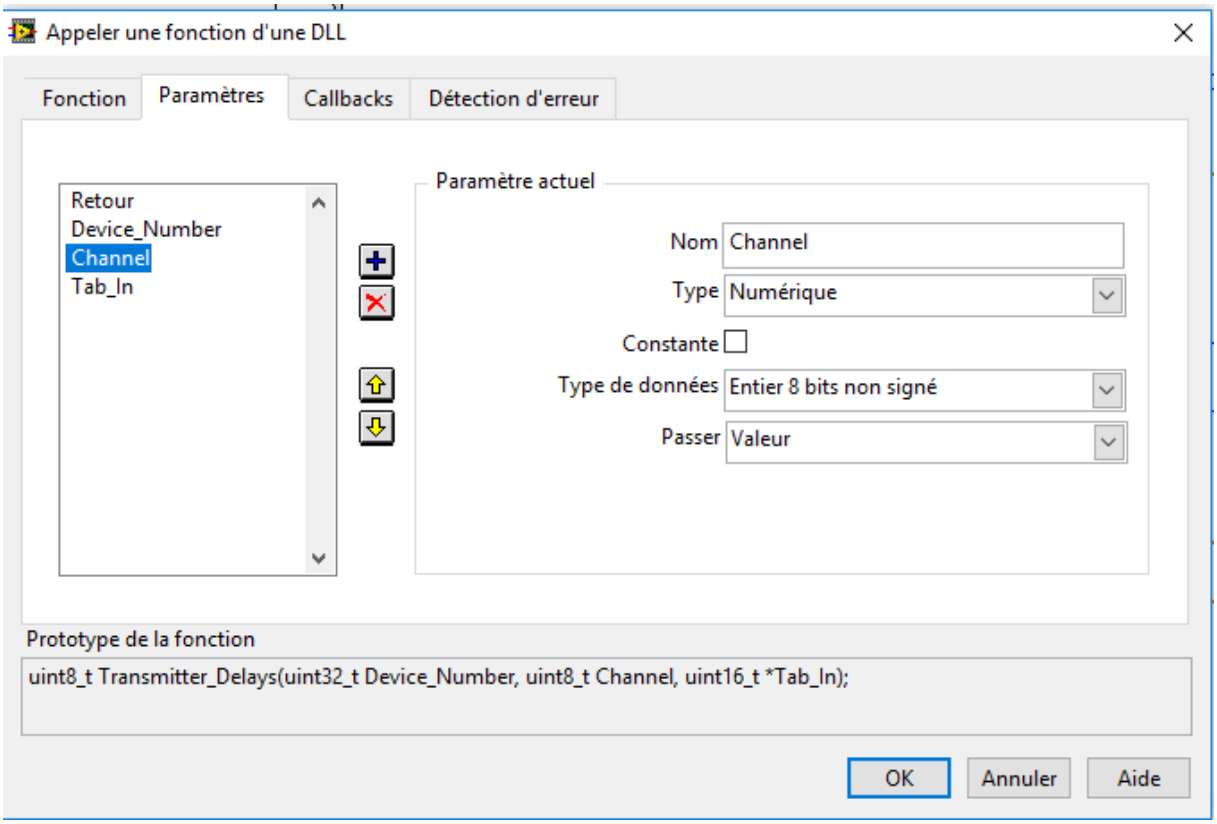

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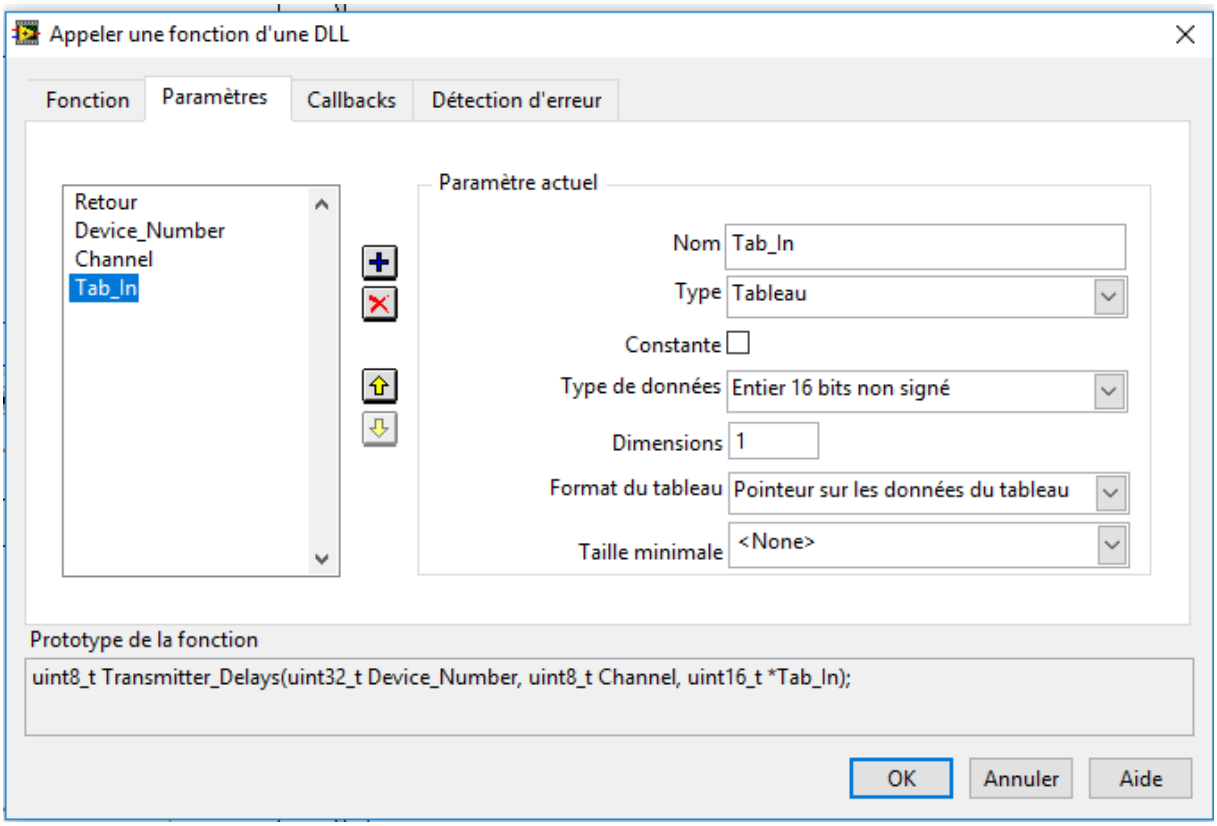

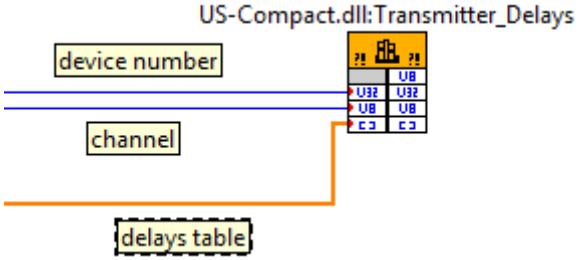

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Transmitters_Waveforms

Description :

This function allows to program waveforms on each transmitter.

For each channel a table is sent to the hardware. It contains the shape of each waveform for all the sequences. This function must be used with the « size_wave » function wich set the lenght of the wave for the sequences.

Example :

size wave = 12 (number of values sent to define the waveforms)

Waveform for sequence 1

value 1 : always 1

value 2 : positive state for Waveform 1-> 1024+ state width (25 ns step)

value 3 : negative state for Waveform 1 -> 2048 + state width (25 ns step)

value 4 : delay after waveform 1 -> delay (25 ns step)

value 5 : delay before waveform 2 -> delay (25 ns step)

value 6 : positive state for Waveform 2-> 1024+ state width (25 ns step)

value 7 : negative state for Waveform 2 -> 2048 + state width (25 ns step)

value 8 : delay after waveform 2 -> delay (25 ns step)

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value 9 : delay before waveform 3 -> delay (25 ns step)

value 10 : positive state for Waveform 3-> 1024+ state width (25 ns step)

value 11 : negative state for Waveform 3 -> 2048 + state width (25 ns step)

value 12 : always 1

Waveform for sequence 2

value 13 : always 1

value 14 : positive state for Waveform 1-> 1024+ state width (25 ns step)

value 15 : negative state for Waveform 1 -> 2048 + state width (25 ns step)

value 16 : delay after waveform 1 -> delay (25 ns step)

value 17 : delay before waveform 2 -> delay (25 ns step)

value 18 : positive state for Waveform 2-> 1024+ state width (25 ns step)

value 19 : negative state for Waveform 2 -> 2048 + state width (25 ns step)

value 20 : delay after waveform 2 -> delay (25 ns step)

value 21 : delay before waveform 3 -> delay (25 ns step)

value 22 : positive state for Waveform 3-> 1024+ state width (25 ns step)

value 23 : negative state for Waveform 3 -> 2048 + state width (25 ns step)

value 24 : always 1

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EXAMPLE 1

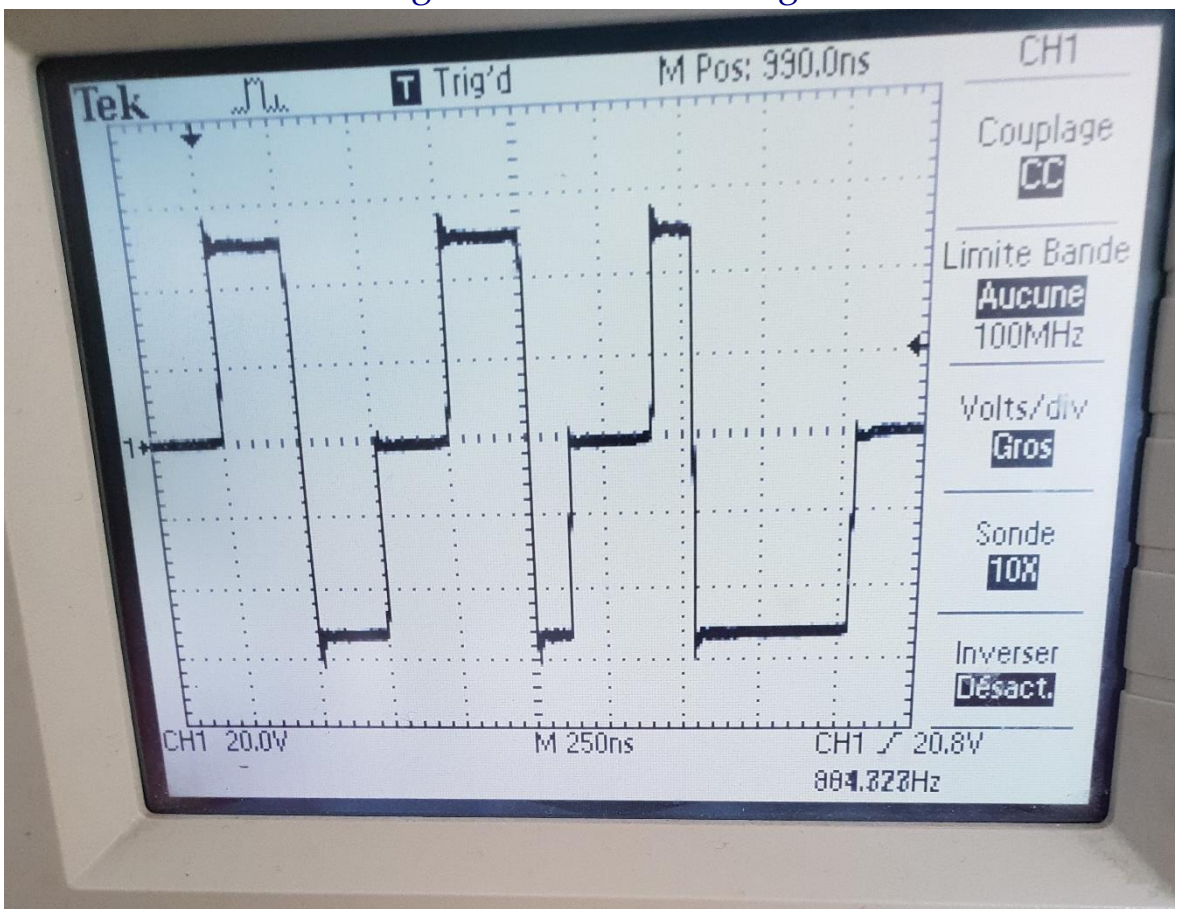
Table Values :

1
1024 + 10
2048 +10
9

1
1024+10
2048+5
10

1
1024+5
2048+20
1

This table generates the following waveform



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EXAMPLE 2

Table Values :

1
1024 + 9
2048 +9
1

1
1024+9
2048+9
1

1
1024+9
2048+9
1

This table generates the following waveform

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Features :

Step size : 25 nS

Memory size : 16384 Values for each channel

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

*Transmitter_Wave(Device_Number.l,Channel.a,*Tab_In)*

Device_Number.l : set the number of usb device (0 for one us-array)

Channel.a : set the channel number (1 to 32)

*Tab_In : Table of waves values for all sequences. Each value is unsigned 16.

With Matlab

Declaration :

```
loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');
```

Calling the function :

```
j = 0;
Tab_In = ones(1,135168,'uint16');
for i=1:32
    Channel = i-1;              % Channel selection

  Tab_In(1) = 1;                % First Wave
```

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```
    Tab_In(2) = 20+1024;
    Tab_In(3) = 20+2048;
    Tab_In(4) = 1;

    Tab_In(5) = 1;              % second wave
    Tab_In(6) = 20+1024;
    Tab_In(7) = 20+2048;
    Tab_In(8) = 1;

    Tab_In(9) = 1;              % Third wave
    Tab_In(10) = 20+2048;
    Tab_In(11) = 20+1024;
    Tab_In(12) = 1;


    [Retour] =
calllib('MyDLL','Transmitter_Wave',Device_Number,Channel,Tab_In);
    Tab_In = ones(1,135168,'uint16');


end
```

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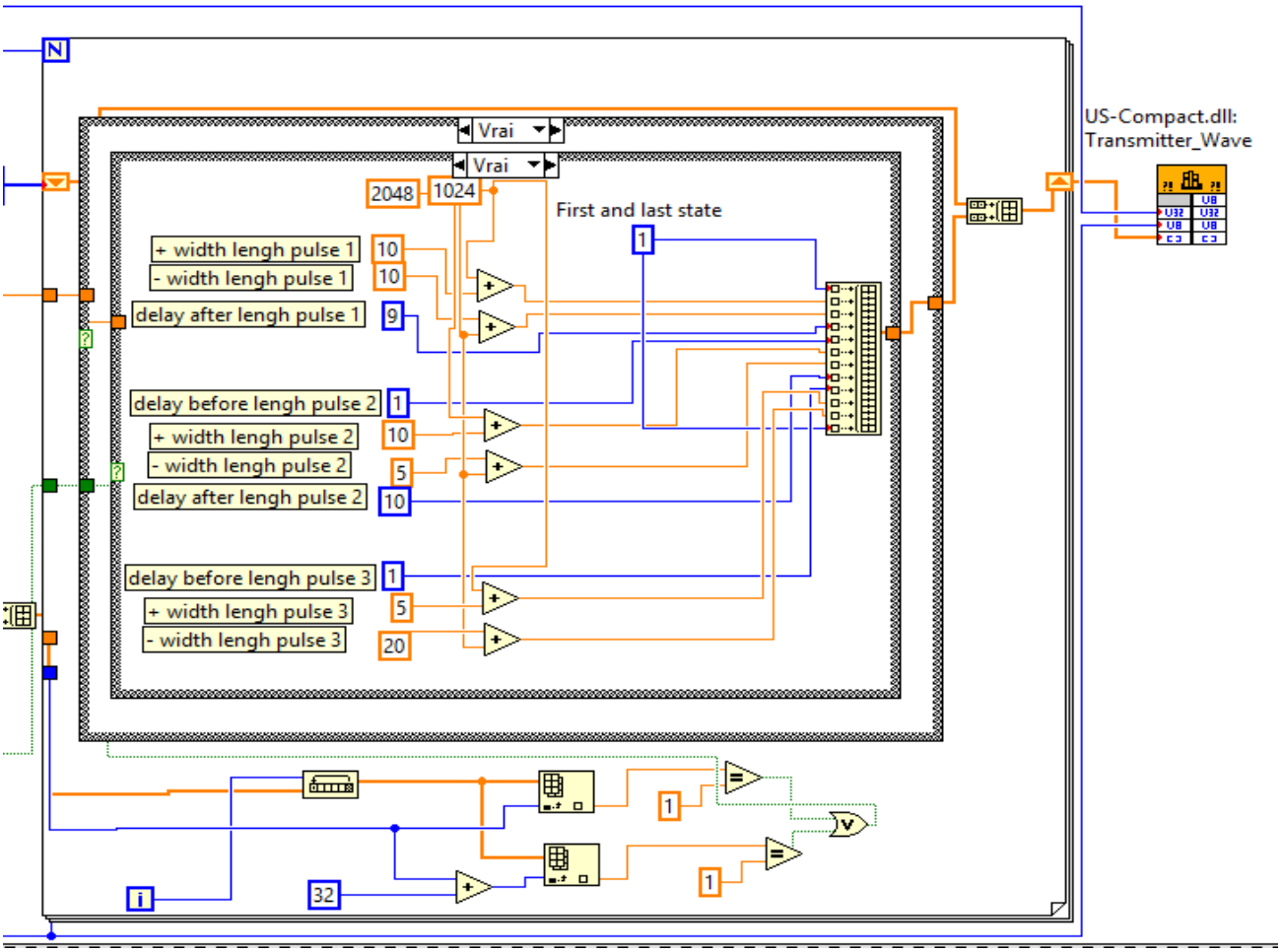
With Labview



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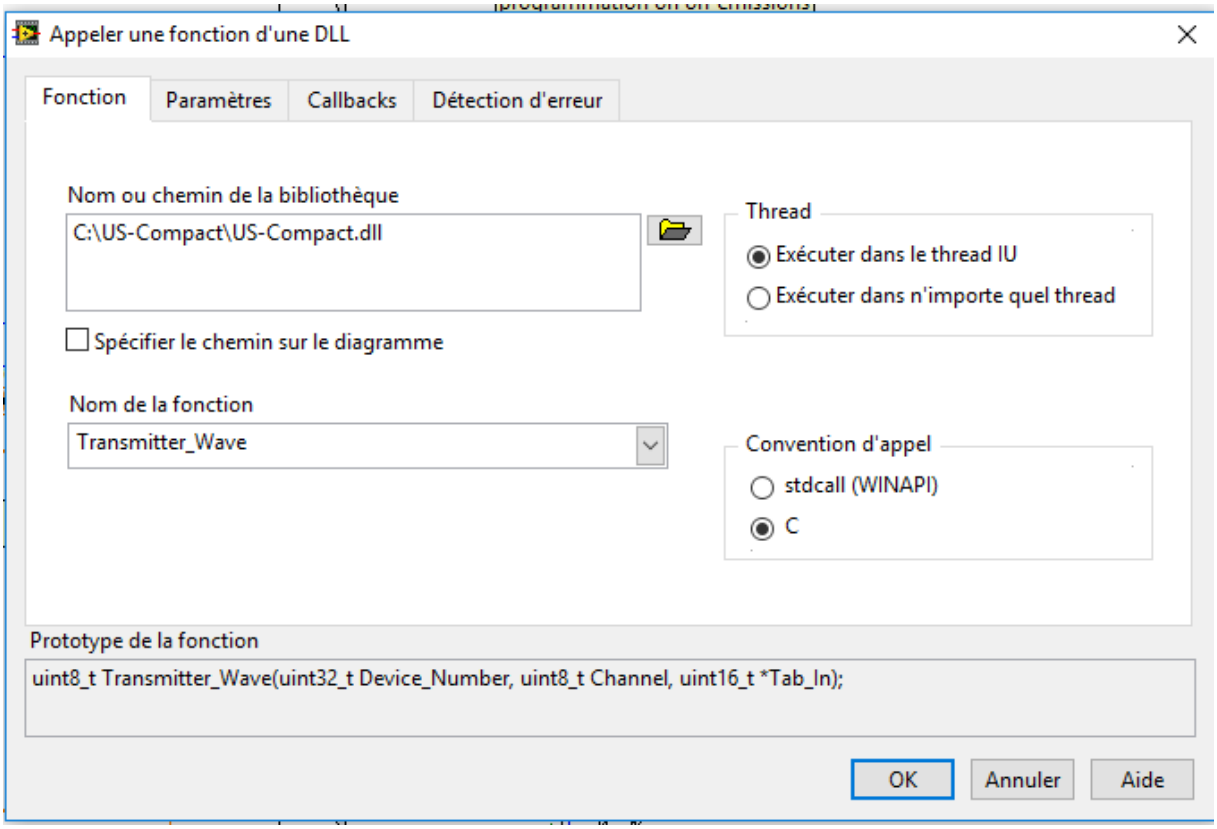

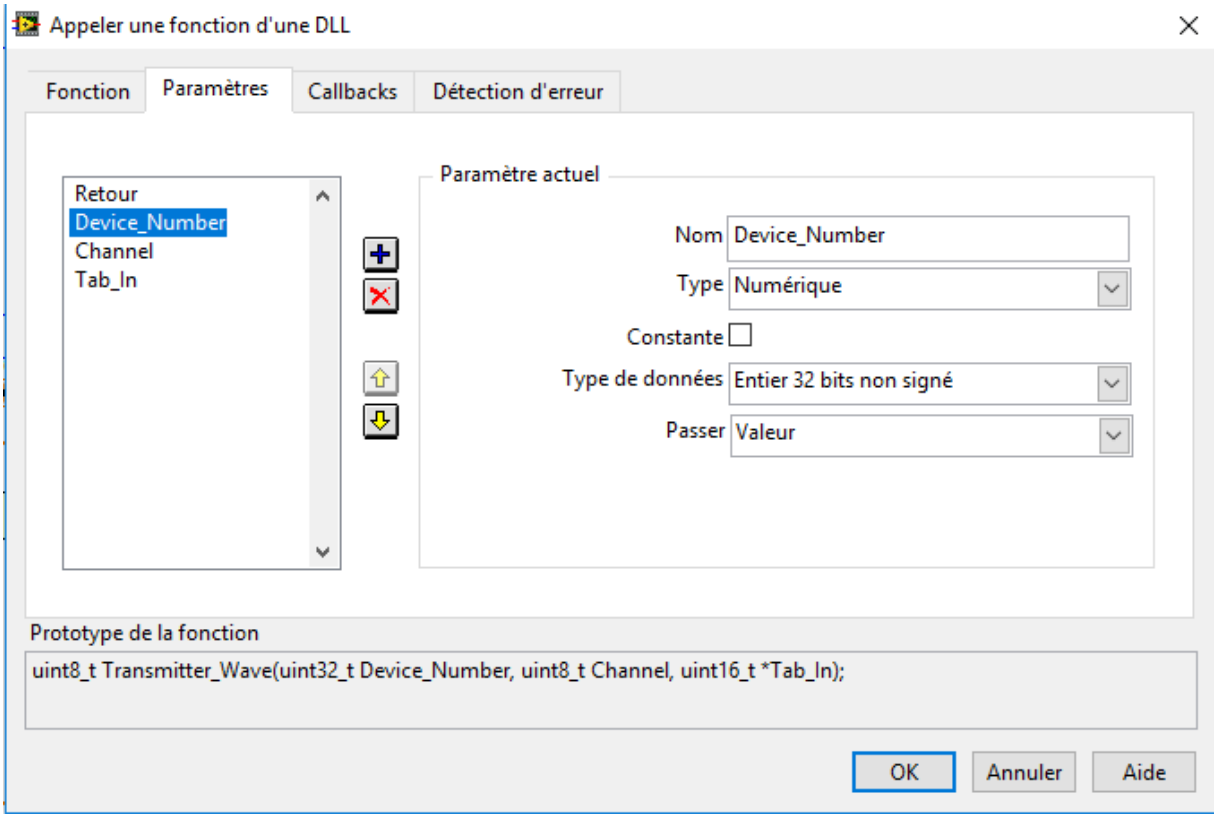

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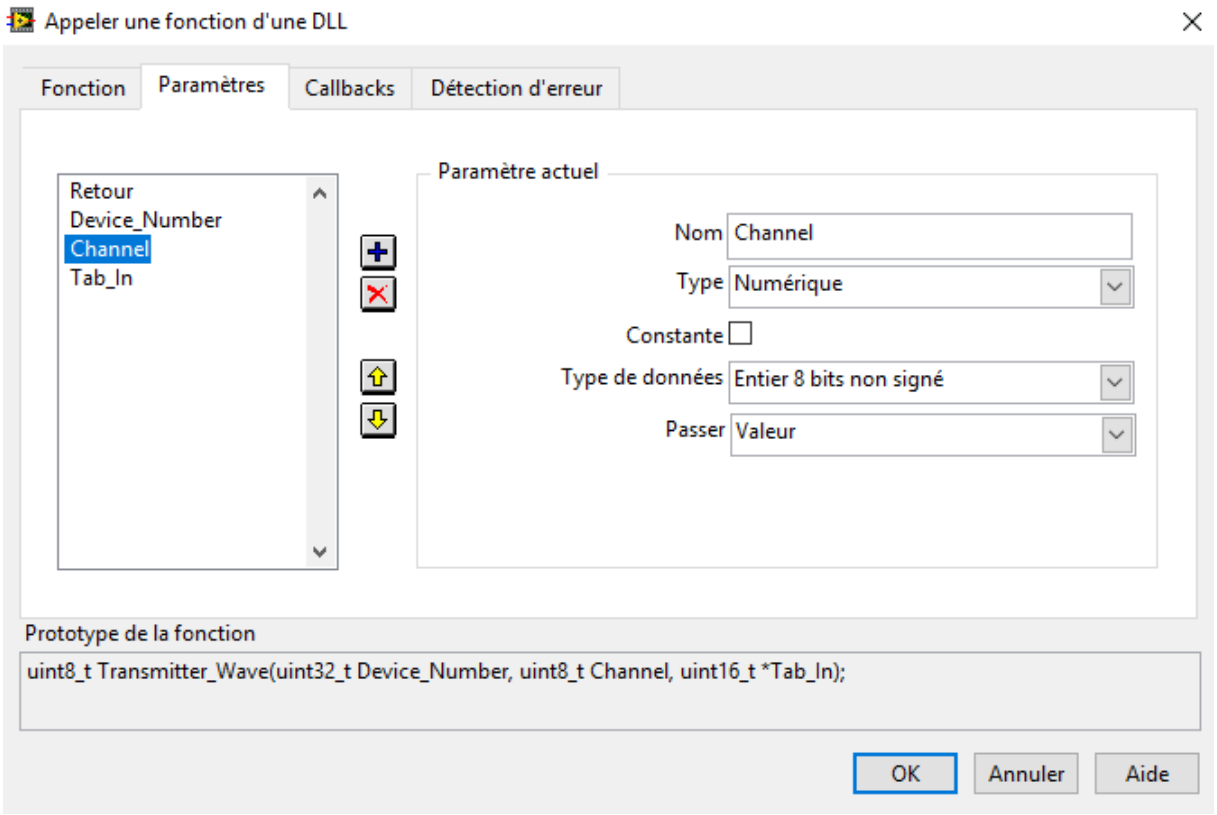

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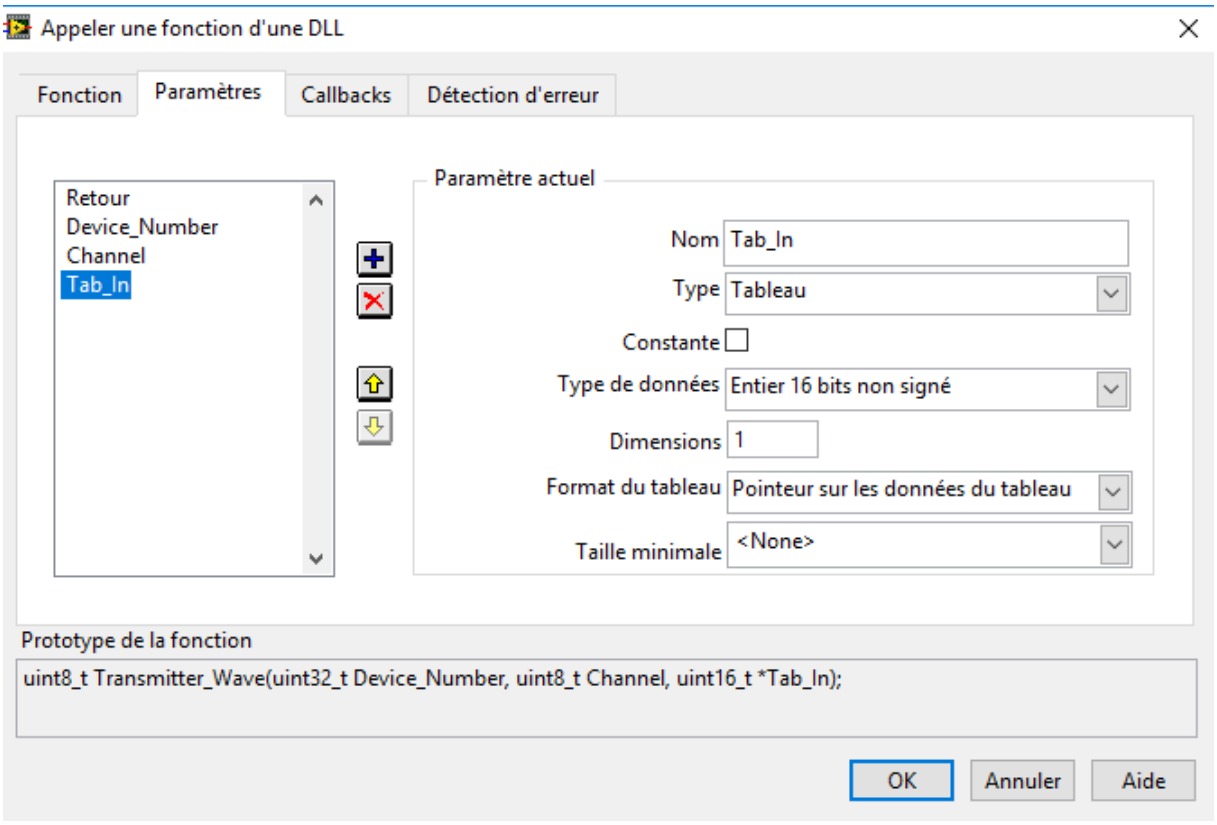

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Size_Wave

Description :

Set the length of the transmitter wave (in words) for each sequence.

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

Size_Wave(Device_Number.l,Size.u))

Device_Number.l : set the number of usb device (0 for one us-array)

Size.u : value from 4 to 16384

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With Matlab

Declaration :

```
loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');
```

Calling the function :

```
Size_Wave = 4;                % always a multiple of 4 because a transmitter wave is composed with basic waveforms : delay before state / positive state /negative state / delay after state

[Retour] = calllib('MyDLL','Size_Wave',Device_Number,Size_Wave);
```

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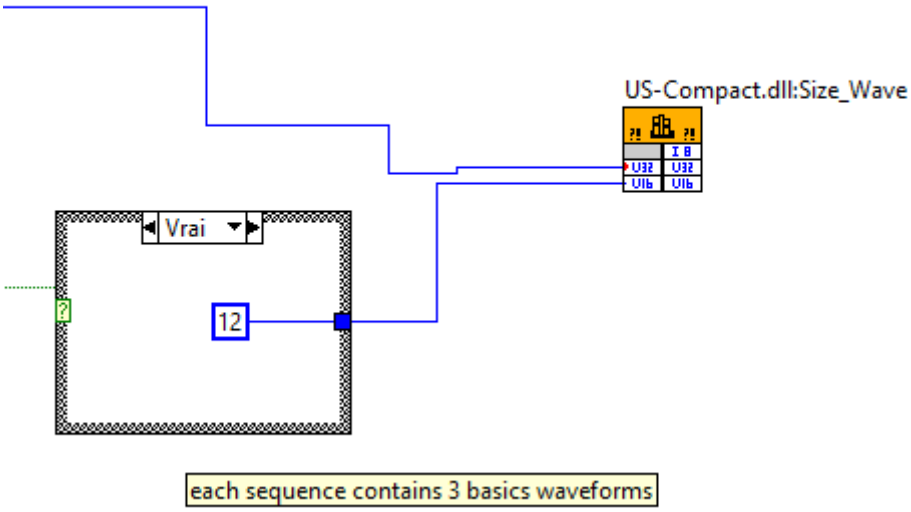
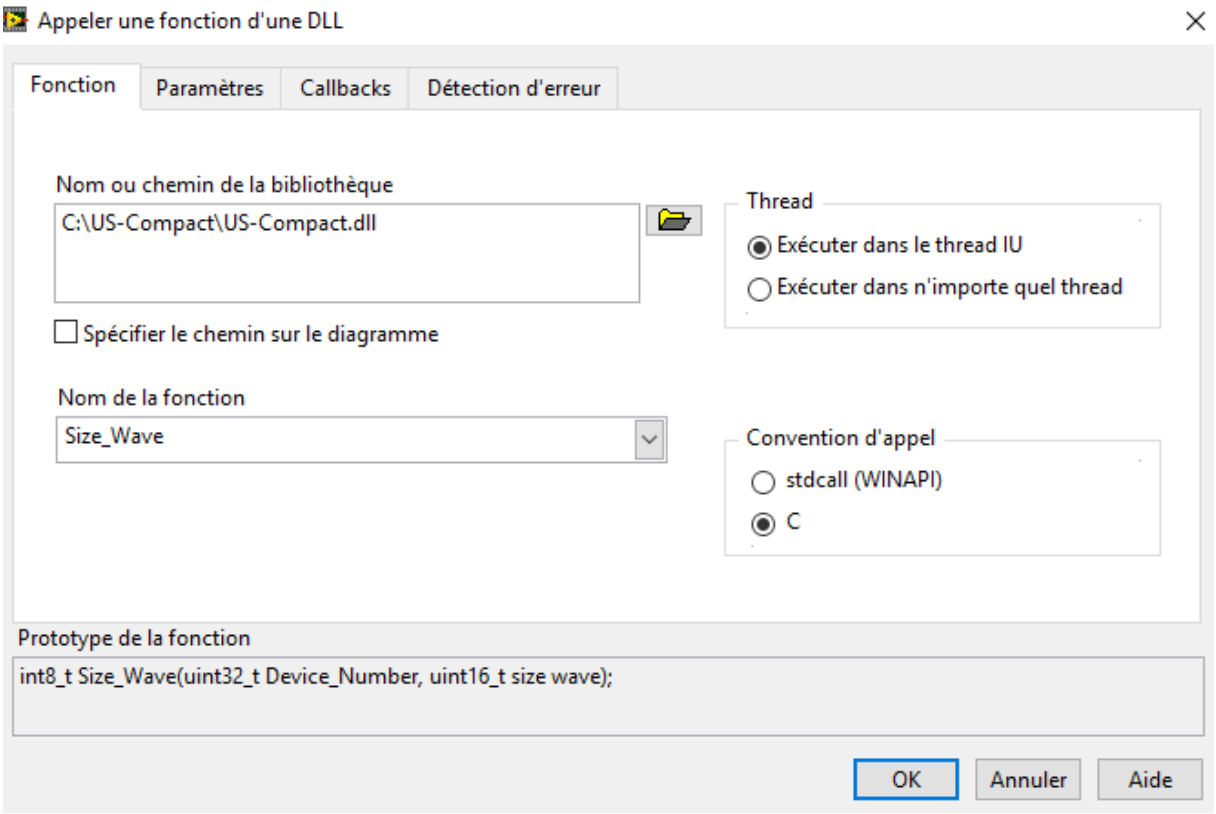
With Labview





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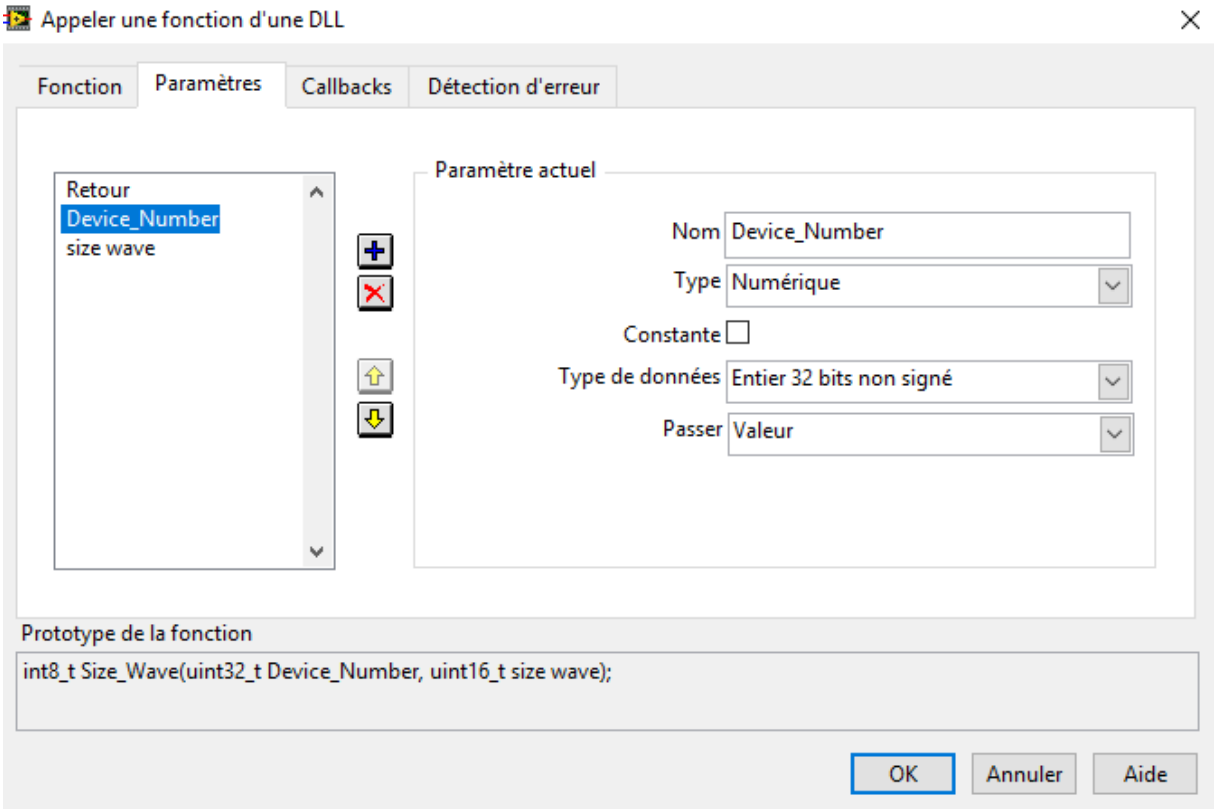

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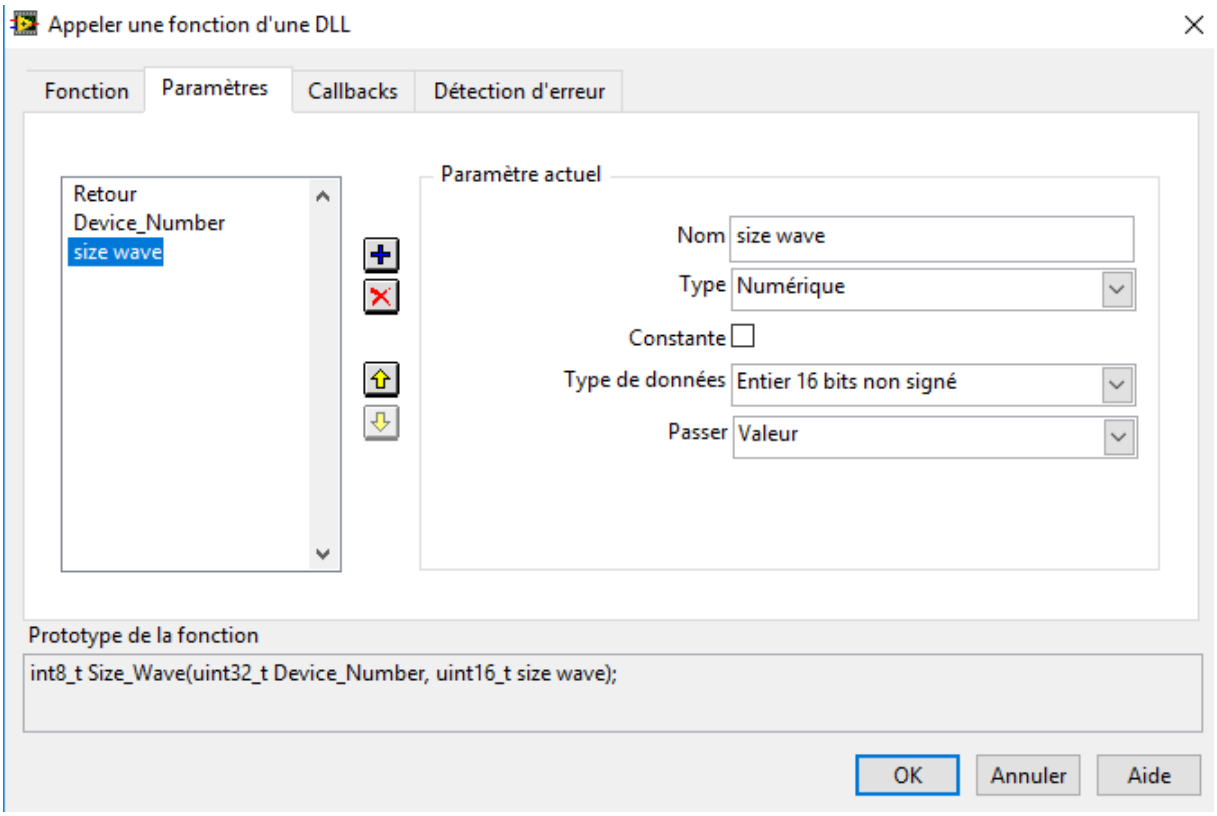

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Sampling_Freq

Description :

Set the sampling frequency for the ADC .

1-> 80 MHz

2-> 40 MHz

4-> 20 MHz

8-> 10 MHz

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

Sampling_Freq(Device_Number.l,Freq.u)

Device_Number.l : set the number of usb device (0 for one us-array)

Freq.u : value 1 or 2 or 4 or 8

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With Matlab

Declaration :

```
loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');
```

Calling the function :

```
sampling_Freq = 1;                % (1 -> 80 MHz, 2 -> 40 MHz, 4 -> 20 MHz, 8 -> 10 MHz)
[Retour] = calllib('MyDLL','Sampling_Freq',Device_Number,Sampling_Freq);
```

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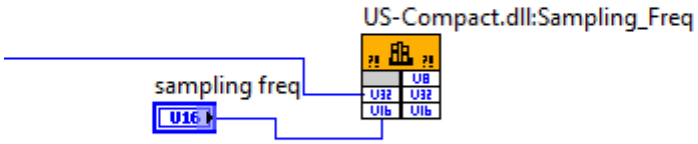
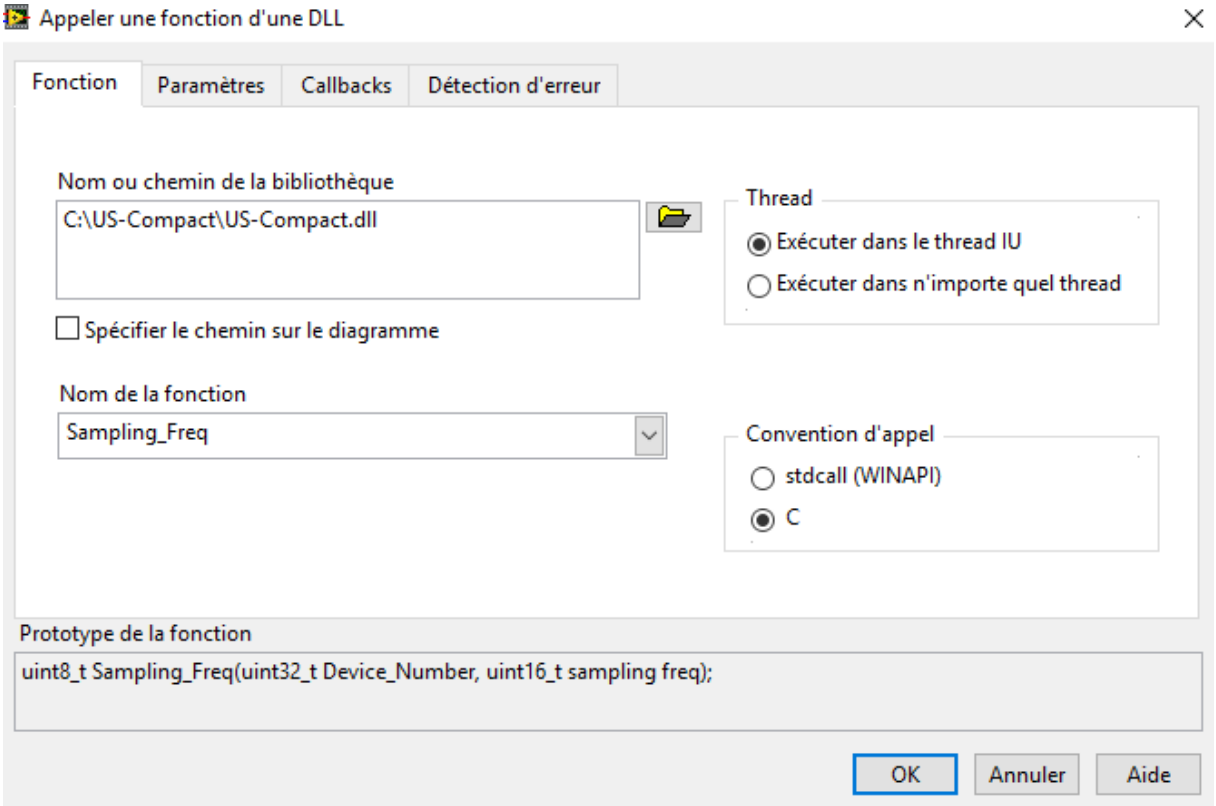
With Labview





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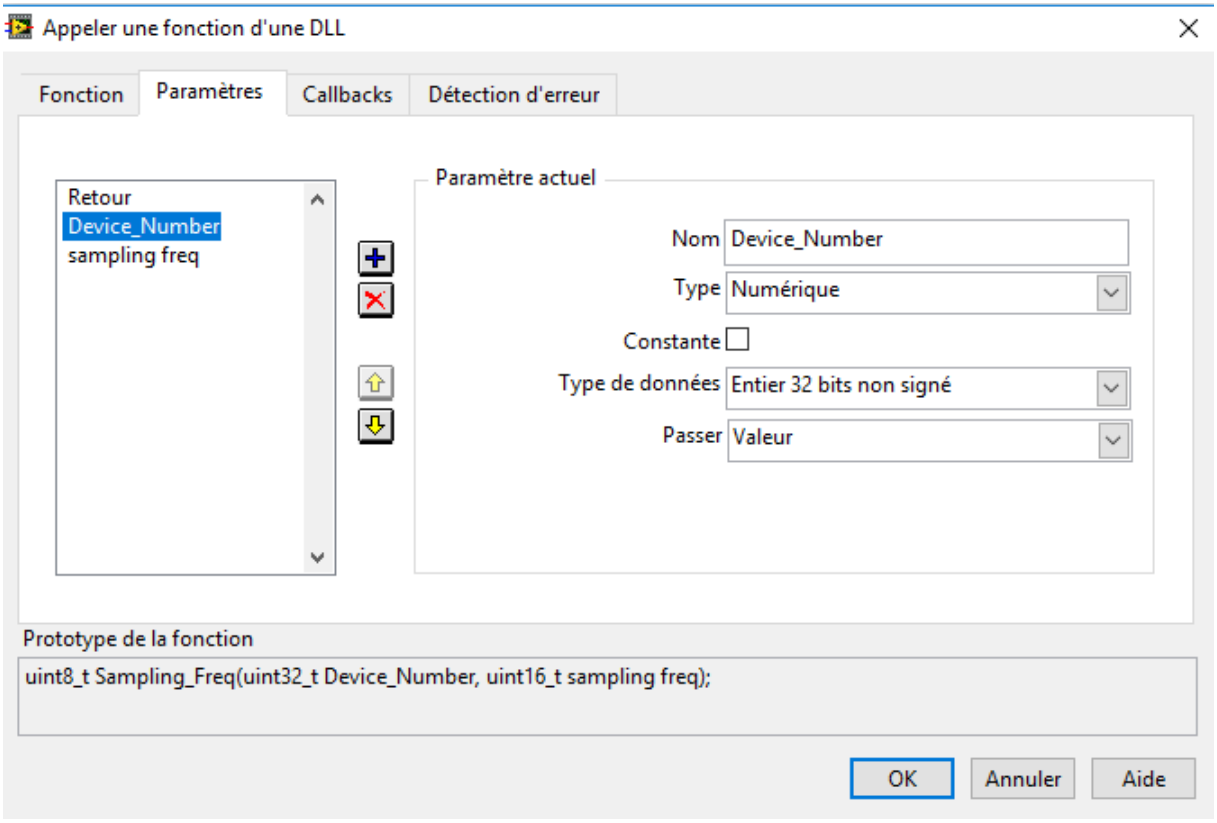

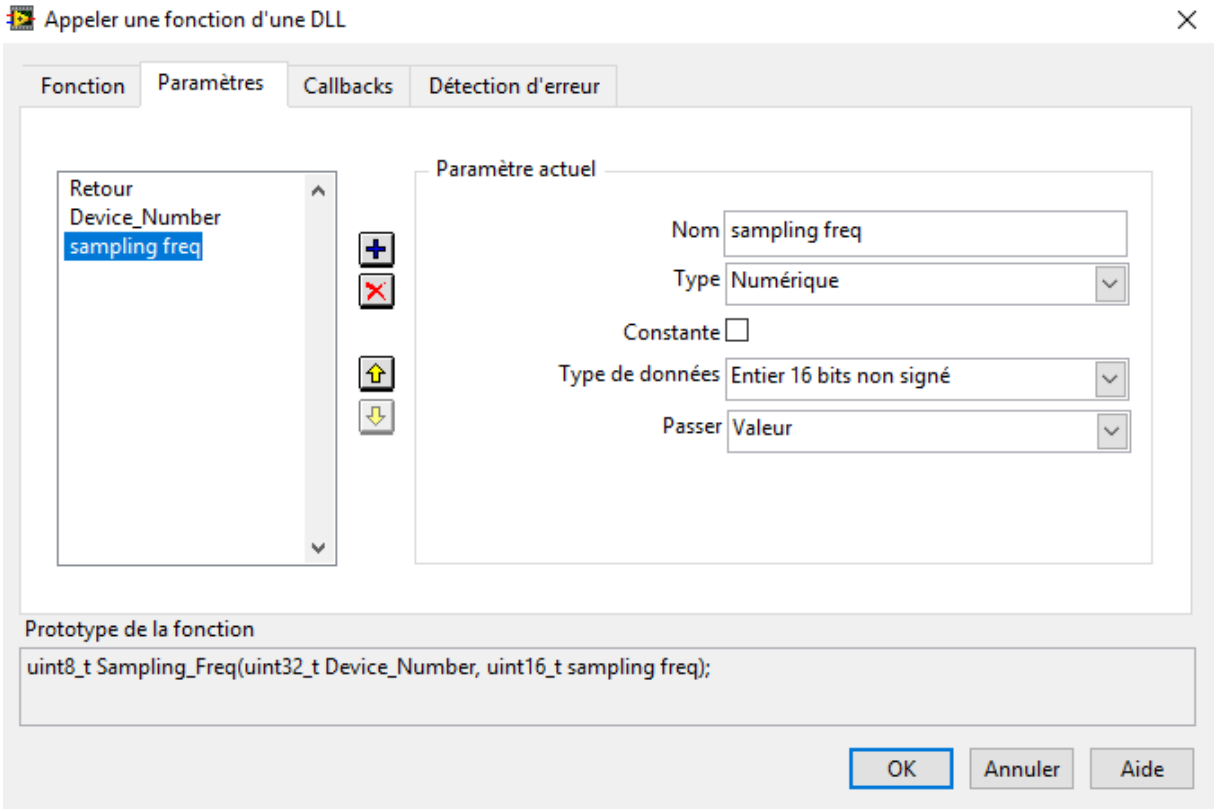

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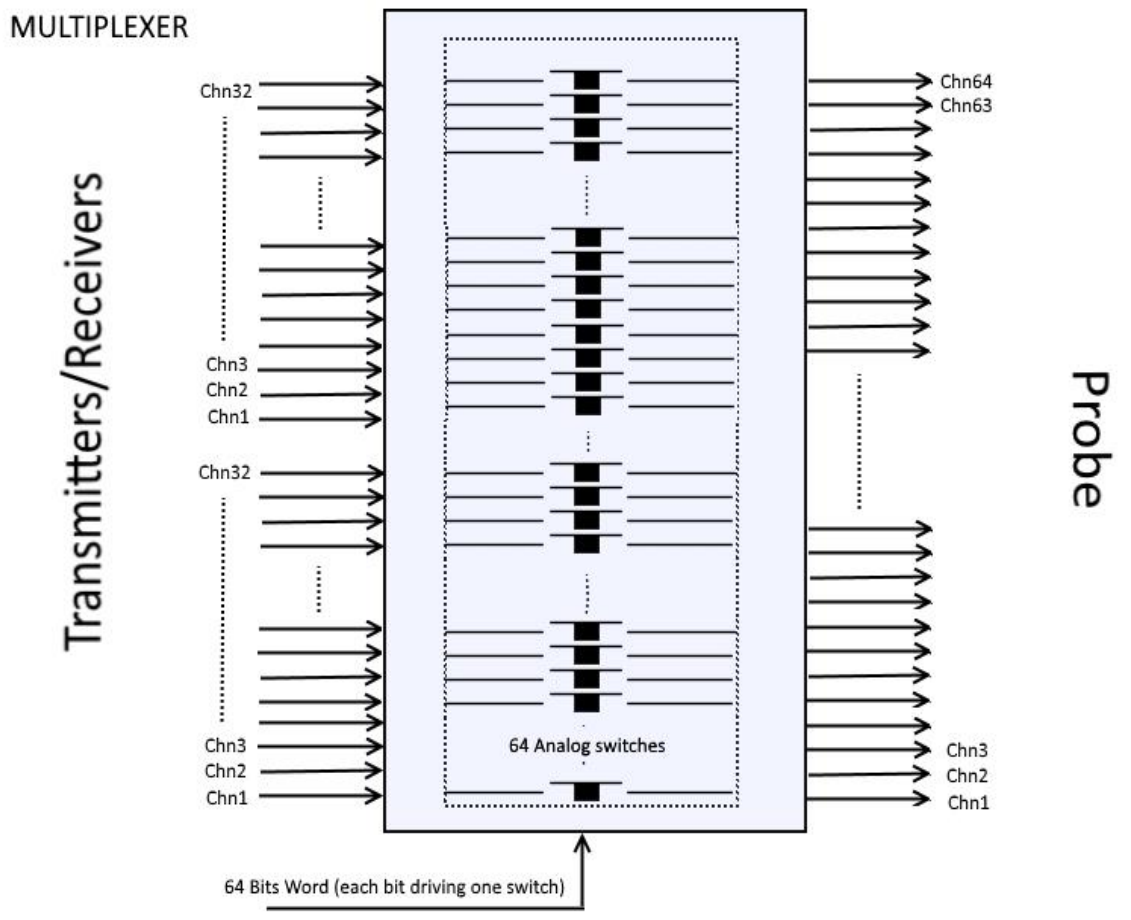
Frame_Mux

Description :

Programs the multiplexer 32 -> 64 channels. For Each sequence a 64 bits word is applied at the input of the multiplexer. Each bit drives a switch of the multiplexer. According to the following drawing



A table composed with all the 64 bits words is sent by calling the DLL. A 64 bits word is composed with four 16 bits words (LSB,LSB-1,MSB-1,MSB). To program all sequences (64) the table size is 256 values.

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Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

*Frame_Mux (Device_Number.l,*Tab_In)*

Device_Number.l : set the number of usb device (0 for one us-array

*Tab_In : Table of multiplexer control words (see before for description)

With Matlab

Declaration :

loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');

```
j = 0;
for i=1:128
    Tab_In(i+j) = i;                %
    Tab_In(i+1+j) = 0;              %
    Tab_In(i+2+j) = 0;              %
    Tab_In(i+3+j) = 0;              %
    j = j + 3;
end
[Retour] = calllib('MyDLL','Frame_Mux',Device_Number,Tab_In);
```

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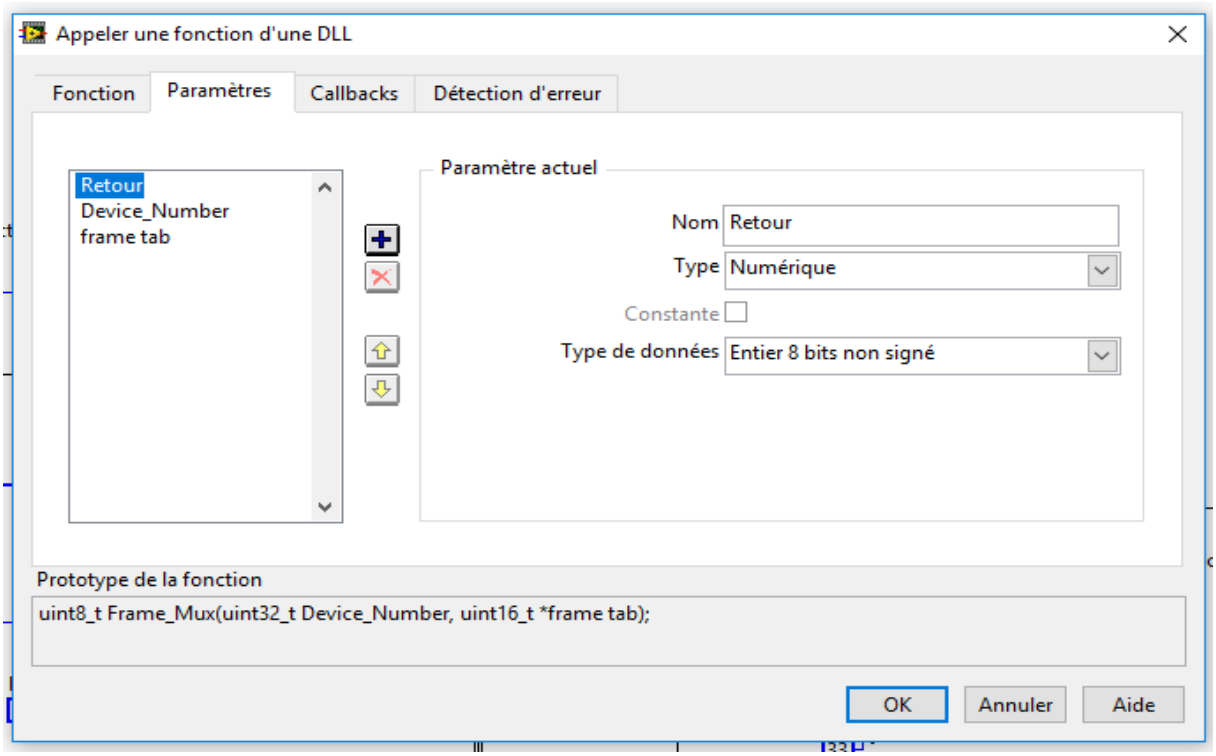
With Labview



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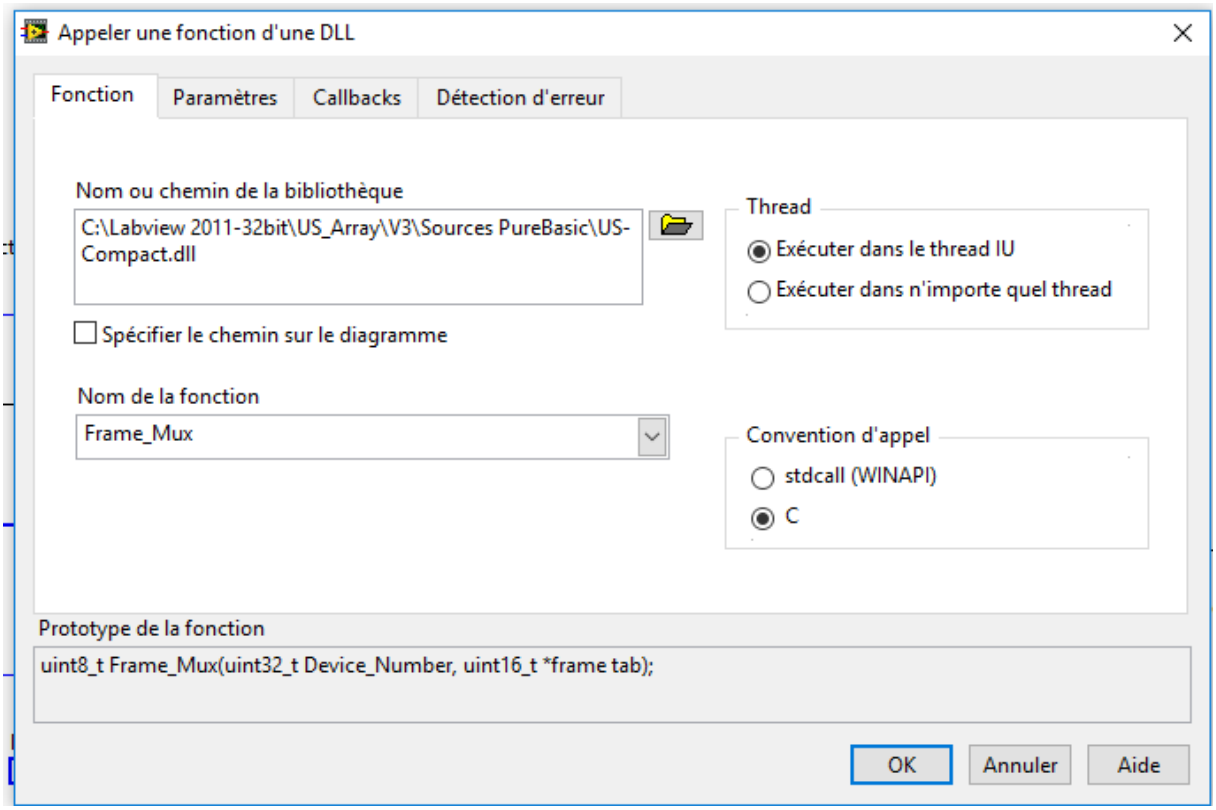

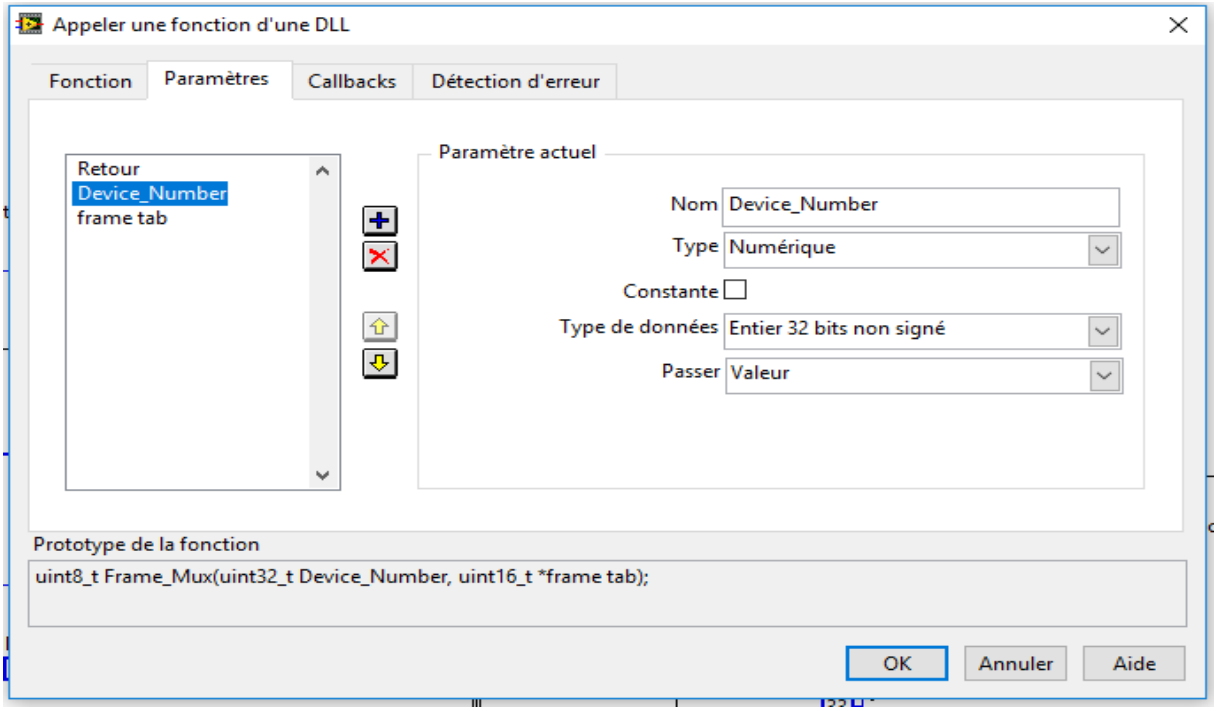

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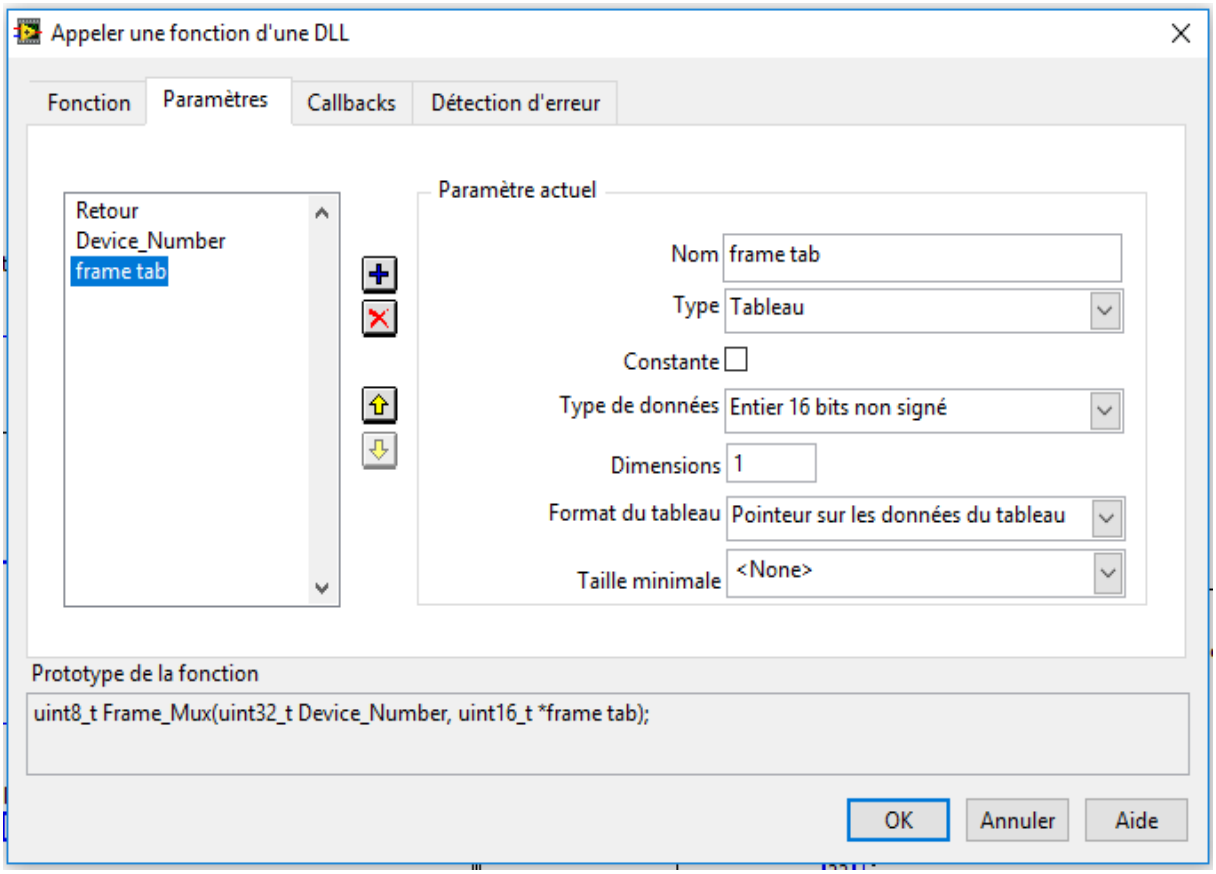

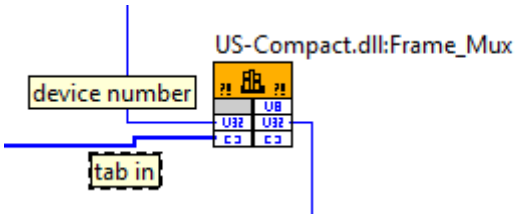

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Data_RF

Description :

This function must be used to acquire RF raws sampled by US-ARRAY CANs. Calling this function returns the RF rows of the 32 Channels. Each RF signal is 4096 samples long. Each sample is a 16 bits (U16) word but the sample is on 10 bits (Six last bits are set to 0) coded from 0 to 1023. The size of the returned table is 4096 * 32 = 131 072 words:

0 - RF channel 1

4096 - RF channel 2

8192 - RF channel 3

…

..

126 976 – RF channel 32

Use :

With : DLL US-Compaq (C:\US-Compact\US-Compact.dll)

*Data_RF (Device_Number.l,*Tab_out)*

Device_Number.l : set the number of usb device (0 for one us-array)

*Tab_out: Table of samples as descripted before (size: 131072).

With Matlab

Declaration :

loadlibrary('C:\US-Compaq\US-Compact.dll','C:\US-Compaq\US-Compact.h','alias','MyDLL');

```
Offset = ones(1,4096*33,'double')*512;                % Tableau utilisé pour centrer le signal sur "0"
tStart = tic;
   [Retour Data] = calllib('MyDLL','Data_RF',Device_Number,Tab_In);          % 32 Channels acquisition
   tElapsed = toc(tStart);                                % Channel  N°2 -> [4097 8192], ...)
   Data = cast(Data,'double');                              % uint16 in double
   Data = Data - Offset;                                  % signal normalisation
   plot(Data*double(0.002));                               % volts conversion
   xlabel('Samples','FontSize',14);
   ylabel('Volts','FontSize',14);
   axis([1 4096 -1 1]);
   drawnow;
```

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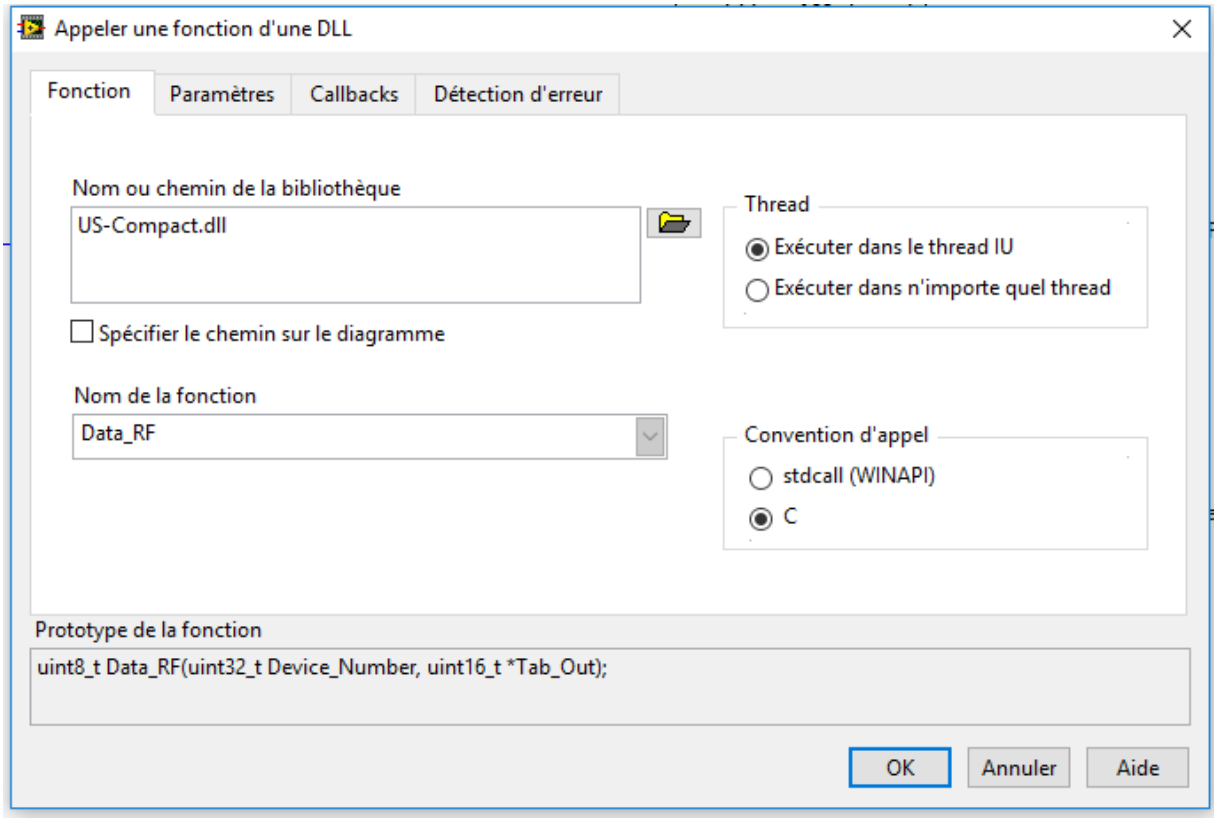
With Labview



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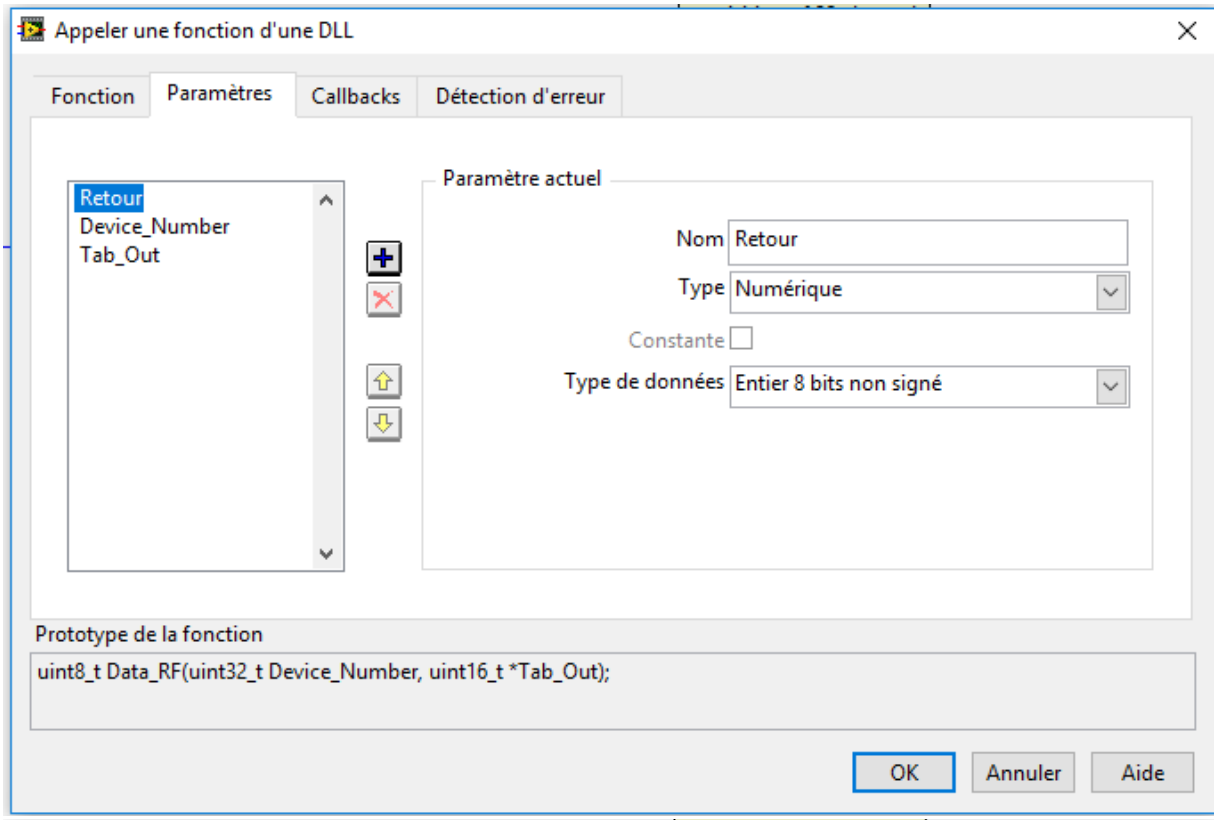

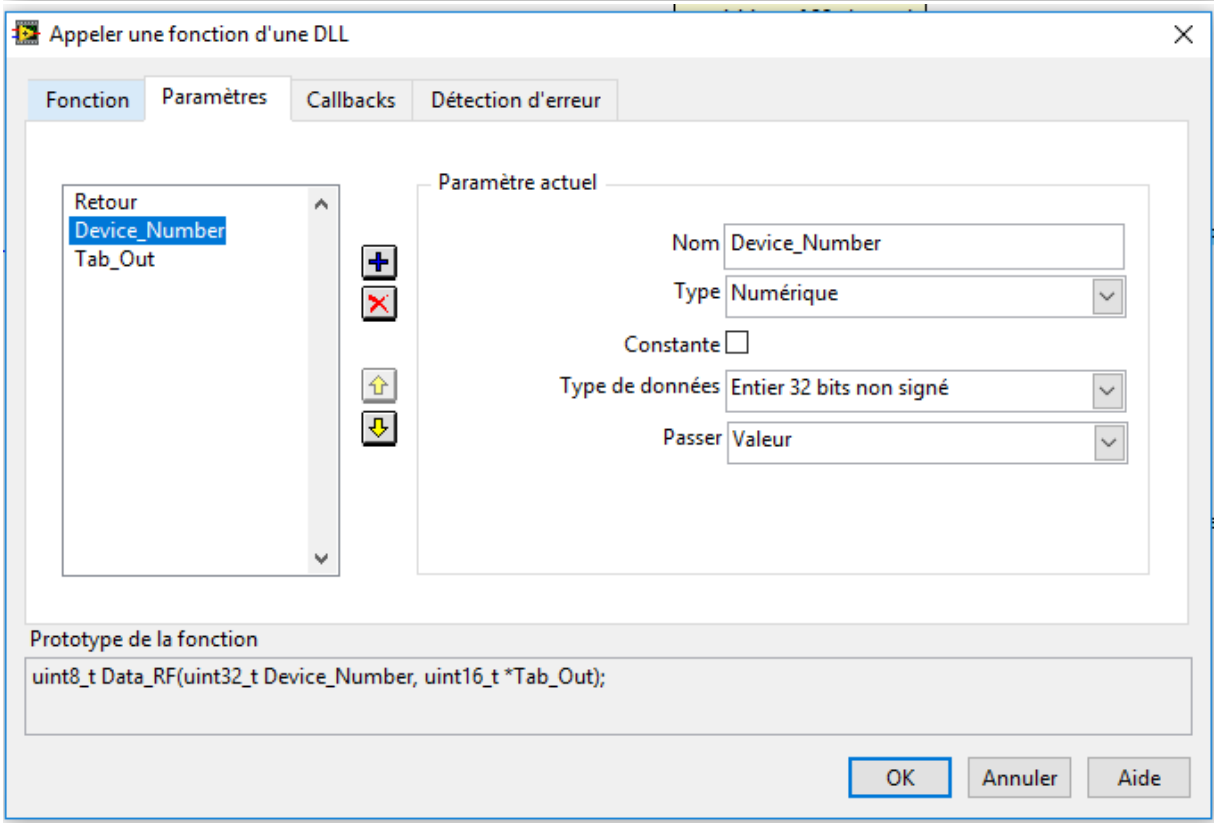

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