

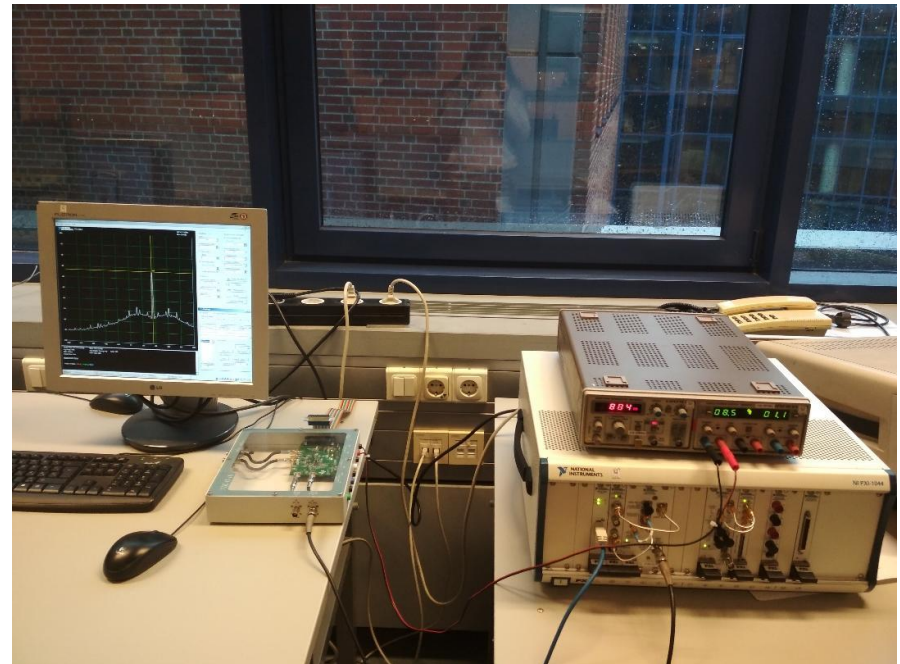
MSc Project Laboratory 2

# Automated Functional Test of Wireless Embedded Transmitter

Supervisor: Tamas Krebesz  
Student: Aizhan Beisenbay  
Student code: MHYKBH

# Project Overview

- This project's goal is implementation of an automated test system a TRF6900A FSK transceiver produced by Texas Instruments.
- In Spring 2018 we are analyzing and implementing communication protocol with the board



# Measurements



- Generated frequency and frequency error
- Output power in power amplifier settings
- Bandwidth of Phase Locked Loop
- Spectrum and Bandwidth of FSK signal
- RSSI characteristics
- IF output
- etc...

Markers

ON/OFF  Show Values on Main Display

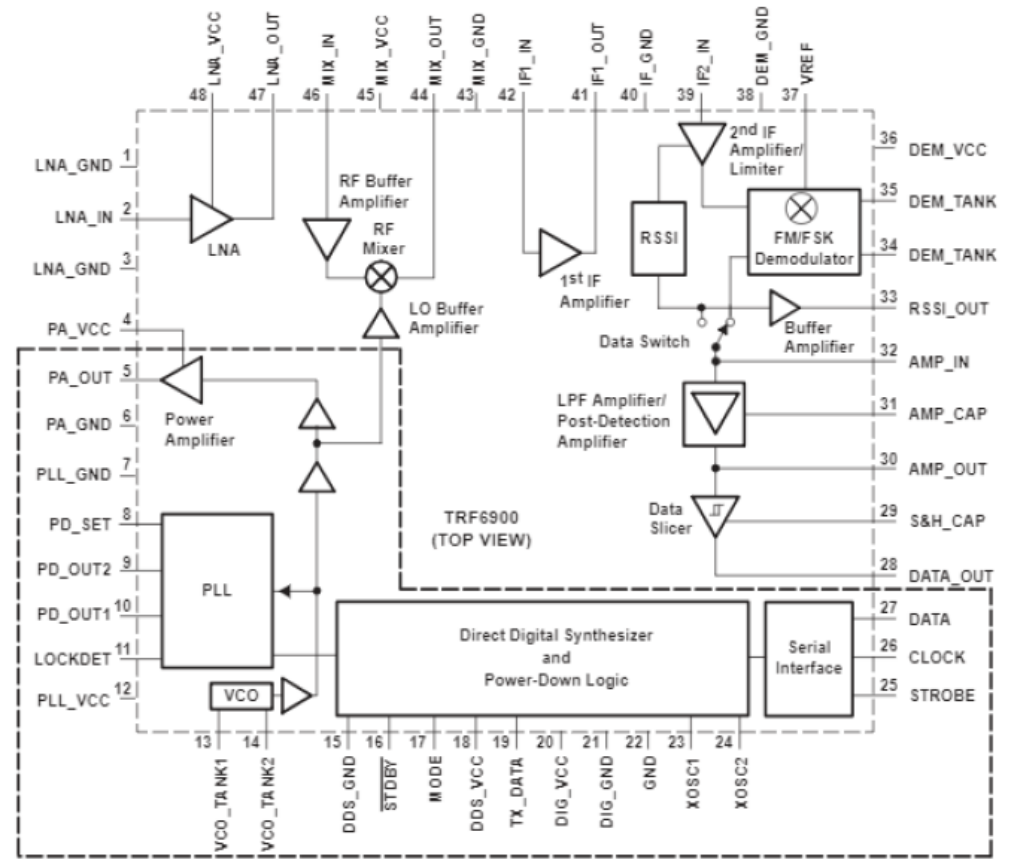
Marker Enabled

1  2  3  4  5  6  7  8  9

	Frequency	Level
Ref Marker	915.036103MHz	-33.09dBm

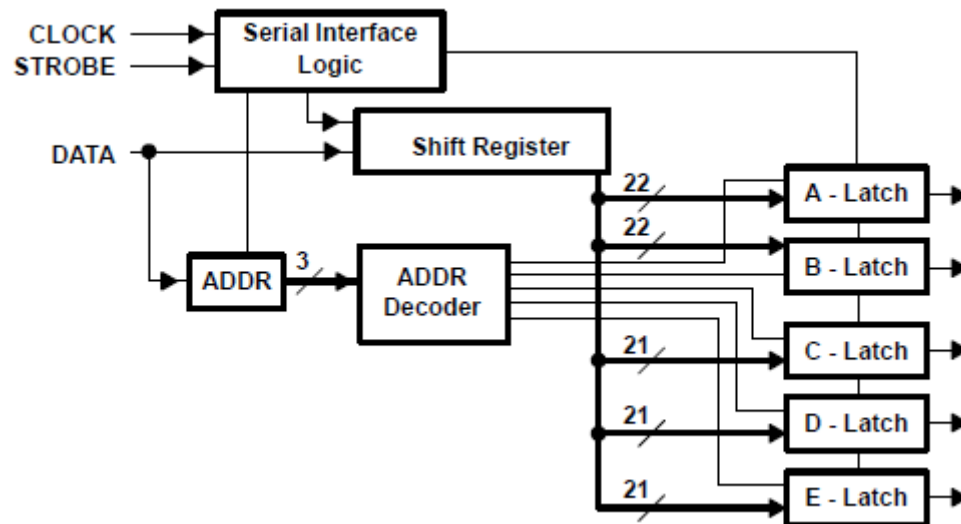
# TRF6900A

- RF Transceiver for 868-MHz and 915-MHz ISM Bands
- FM/FSK Operation for Transmit and Receive



# TRF6900A

- The internal registers contain all user programmable variables including the DDS frequency setting registers as well as all control registers.
- To fully program the TRF6900A, four 24-bit words must be sent: the A-, B-, C-, and D-word.



# Codewords

- A ○
- B ○
- C ○
- D ○

The screenshot shows the TRF6900A v4.2 software interface. The window title is "TRF6900A v4.2". The menu bar includes "File", "Edit", "Go", and "Help".

**Synthesizer**

- CLK: 26.0 MHz
- Desired Freq: 915.000000 MHz
- Actual Freq: 914.999969 MHz
- Freq. Error: 0 MHz
- Update CLK button

**PreScaler**: 256

**Mode Options**

PLL	On	DSW	LIM
VCO	On	RSSI	Off
Pwr Amp	Off	LIM	Off
Slicer	On	IF	Off
SLCTL	Learn	MIX	Off
LPF	Off	LNA	High

**PLL and MM Options**

APLL	140
NPLL	256
MM	FSK

**LPT Port**

LPT\_x: 1

**Output Parameters**

Enable	On	TXData	Off	Mode	0
Clock Width	345	Strobe Width	675		

**Help**

Mode of the TRF6900

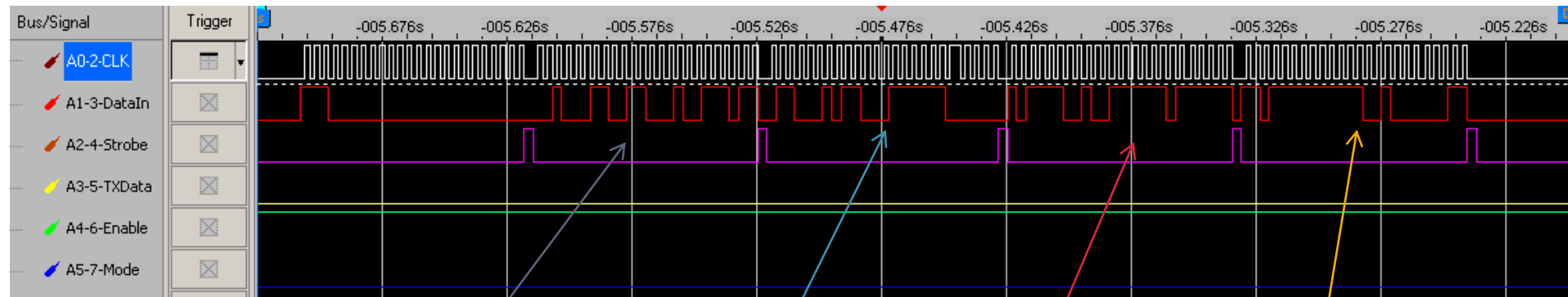
- 0: Word A and Word D
- 1: Word B and Word C

**Words** Send Words Now (F12)

A	001000110011000100111011	Mode 0
B	011000101100011111100000	Mode 1
C	101111001001111110111111	Mode 1
D	110111111111100100000011	Mode 0

**Operation Mode:** Mode 0 TXData:Off Chip On

# Codewords



A word

B word

C word

D word

Words		Send Words Now (F12)
A	001000110011000100111011	Mode 0
B	011000101100011111100000	Mode 1
C	101111001001111110111111	Mode 1
D	110111111111100100000011	Mode 0

# Frequency setup

DDS Word

2 <sup>23</sup>	2 <sup>22</sup>	2 <sup>21</sup>	2 <sup>20</sup>	2 <sup>19</sup>	2 <sup>18</sup>	2 <sup>17</sup>	2 <sup>16</sup>	2 <sup>15</sup>	2 <sup>14</sup>	2 <sup>13</sup>	2 <sup>12</sup>	2 <sup>11</sup>	2 <sup>10</sup>	2 <sup>09</sup>	2 <sup>08</sup>	2 <sup>07</sup>	2 <sup>06</sup>	2 <sup>05</sup>	2 <sup>04</sup>	2 <sup>03</sup>	2 <sup>02</sup>	2 <sup>01</sup>	2 <sup>00</sup>
0	0	1	0	0	0	1	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0

$$f_{out} = (N) * \frac{f_{ref} * DDS}{2^{24}} \quad \text{rearranging} \quad DDS = \frac{f_{out} * 2^{24}}{f_{ref}} \quad (1)$$

$f_{out}$ : VCO output frequency (the one we set up)

$N$ : divide by ratio of the prescaler

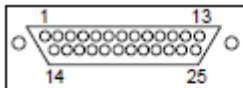
$f_{ref}$ :  $f_{clock}$  system clock frequency

$DDS$ : DDS word value in decimal format



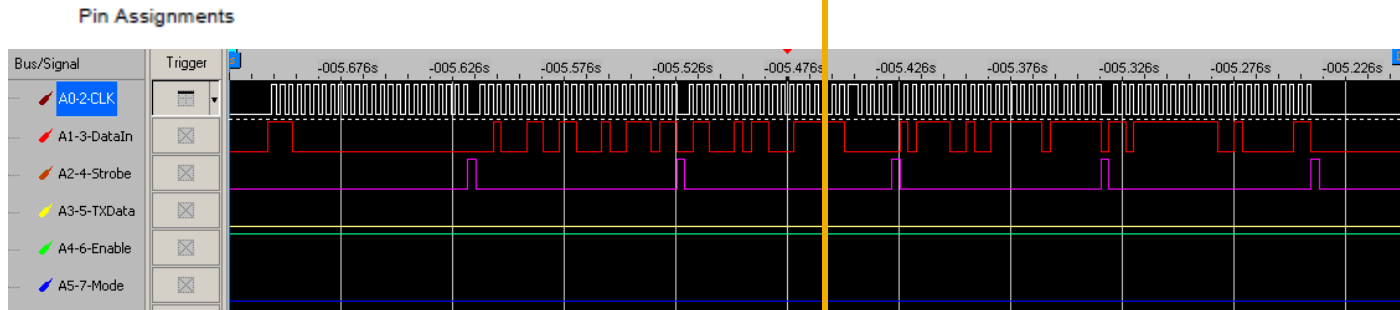
# Communication with TRF6900A

- Standard PC Parallel Port is used
- Pins 2-7 are used by TRF6900 evaluation module as inputs
- Pins 11-12 are used as signals from EVM to computer



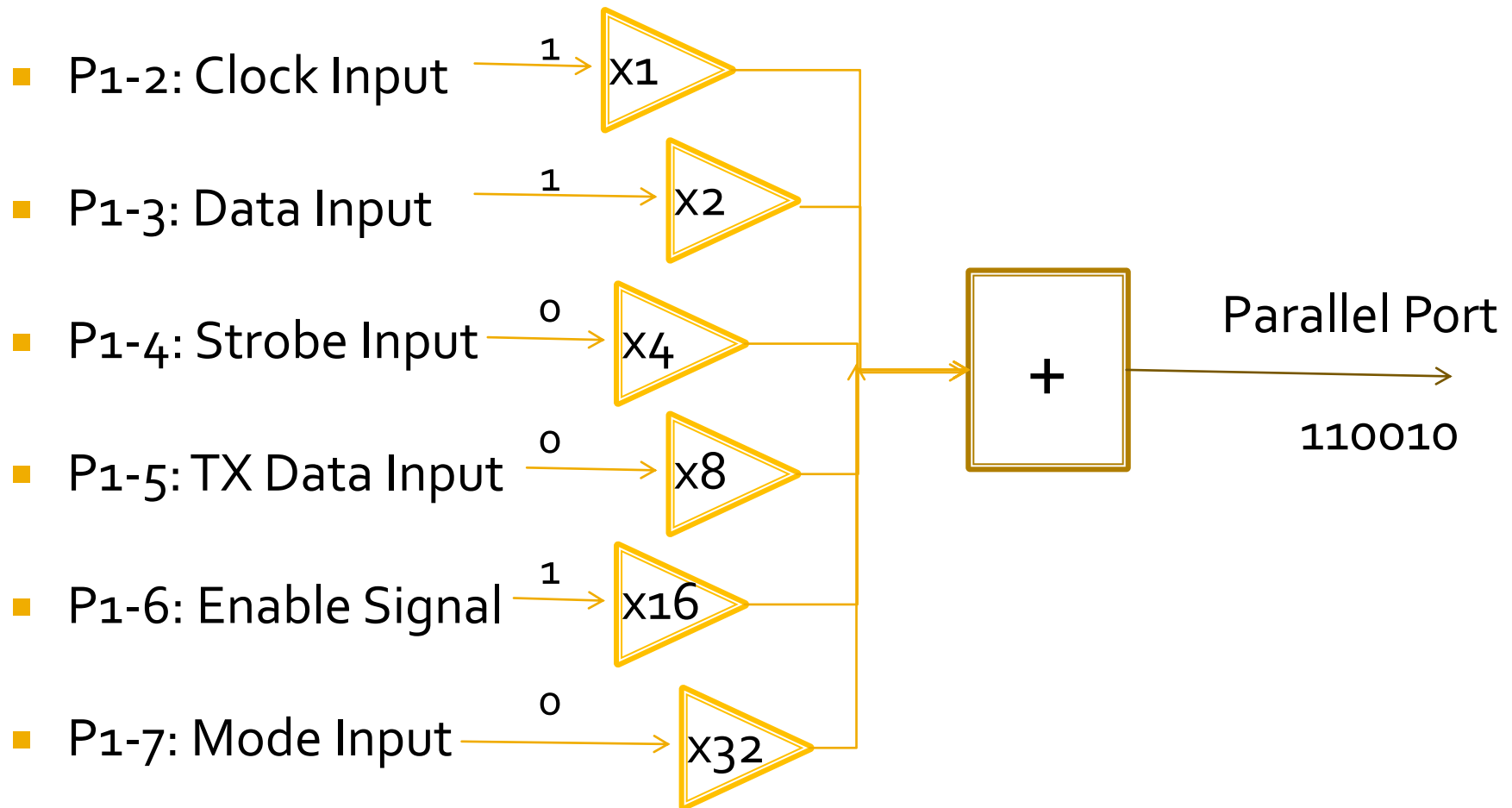
View Is Looking at  
Connector Side of  
DB-25 Male Connector

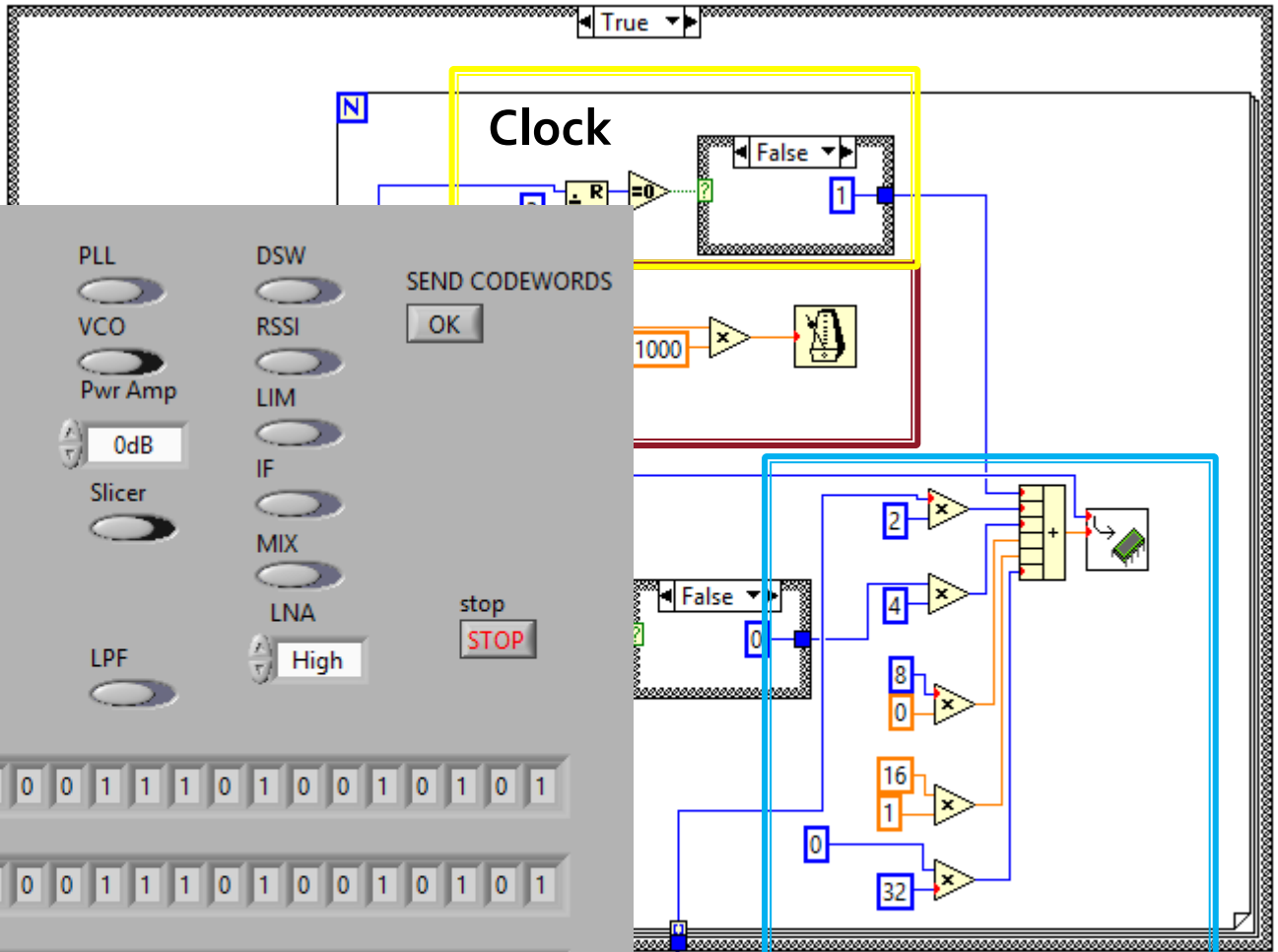
Pin	Description	
1	Strobe	PC Output
2	Data 0	PC Output
3	Data 1	PC Output
4	Data 2	PC Output
5	Data 3	PC Output
6	Data 4	PC Output
7	Data 5	PC Output
8	Data 6	PC Output
9	Data 7	PC Output
10	ACK	PC Input
11	Busy	PC Input
12	Paper Empty	PC Input
13	Select	PC Input
14	Auto Feed	PC Output
15	Error	PC Input
18	Initialize Printer	PC Output
17	Select Input	PC Output



110010

# Communication with TRF6900A





Serial to Parallel conversion

Frequency: 915 MHz

Freq Error: 0 MHz

APLL: 0

NPLL: 256 512

Prescale: 256 512

SLCTL: Hold Learn

PLL:  VCO  Pwr Amp  Slicer  LPF

DSW:  RSSI  LIM  IF  MIX  LNA

SEND CODEWORDS: OK

stop STOP

A word: 0 0 0 0 1 0 0 1 1 1 0 0 0 1 1 1 0 1 0 0 1 0 1 0 1

B word: 0 0 1 0 1 0 0 1 1 1 0 0 0 1 1 1 0 1 0 0 1 0 1 0 1

C word: 0 1 0 1 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 1 1

D word: 0 1 1 0 1 1 1 1 1 1 1 0 0 1 1 0 0 0 0 0 0 0 0 1 1

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**Thank you for your attention**

# References

- [1]"LabVIEW", *En.wikipedia.org*, 2017. [Online]. Available: <https://en.wikipedia.org/wiki/LabVIEW>. [Accessed: 04- Dec- 2017]
- [2]*TRF6900A SINGLE-CHIP RF TRANSCEIVER*. Dallas, Texas: Texas Instruments, 2001.
- [3]"What Is PXI? - National Instruments", *Ni.com*, 2017. [Online]. Available: <http://www.ni.com/pxi/whatis/>. [Accessed: 04- Oct- 2017]
- [4] *TRF6900A Evaluation Board User's Guide*. Dallas, Texas: Texas Instruments, 2001.