Peter van Oostrom.
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# Realization of a Fully Automated High Speed In-line ICT & FCT Test System using *fast*ATE , PXI, LabVIEW and Teststand.

# About us

Sistel Group

DigiProces
ELECTRONICS MANUFACTURING SERVICES

INDIC
EMS ELECTRONICS PVT. LTD.

6TL

SmartLift®

# About 6TL

## Headquarters

Barcelona, Catalonia (one of the main driving forces of the economy in southern Europe)

## Employees

15 highly skilled Soft & Hardware eng.
+ 98 Group resources

NATIONAL INSTRUMENTS Silver Alliance Partner

## 35 Years experience


## International since 2009

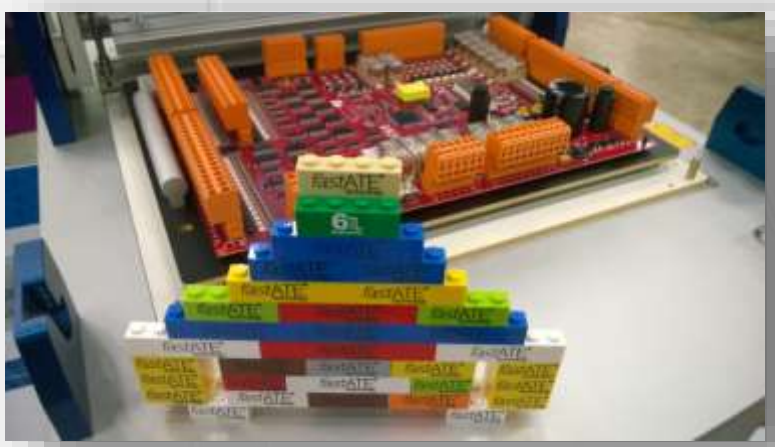
Products sold in more than
35 countries worldwide

# About us

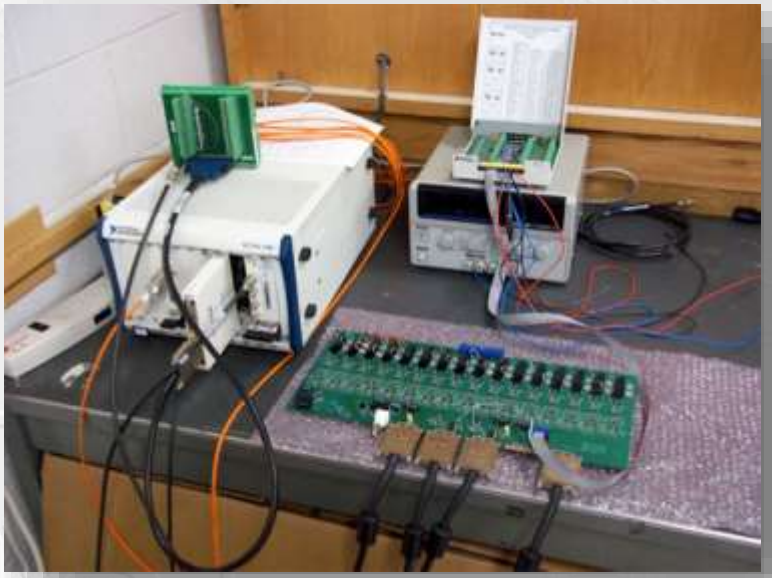
“ We supply innovative products to test system engineers worldwide, by combining modular technologies with a focus on ease of integration, so they can save resources and time while developing and building their ATE's”.

David Batet

General Manager



# About us



"6TL fills the gap between the test experience in the Lab and the corresponding experience in Production Testing".

Enrique Osorio

R+D Manager SA Sistel

# What will be covered.

- Terms explained, ICT, FCT, DFT, DUT, UUT, MIC, *fast*ATE.
- Example of a project we did and how we did it.
  - Design for testability
  - Specifications
  - Test Platform selection
  - Instrumentation Selection
  - Quote & PO
  - Scheduling
  - Test sequence definition
  - Fixturing manufacturing
  - Debugging
  - Delivery and Commissioning
  - After sales services
- Latest news on combinational test (ICT + FCT), Première 6TL-24
- Conclusion and Questions.

# What will be covered.

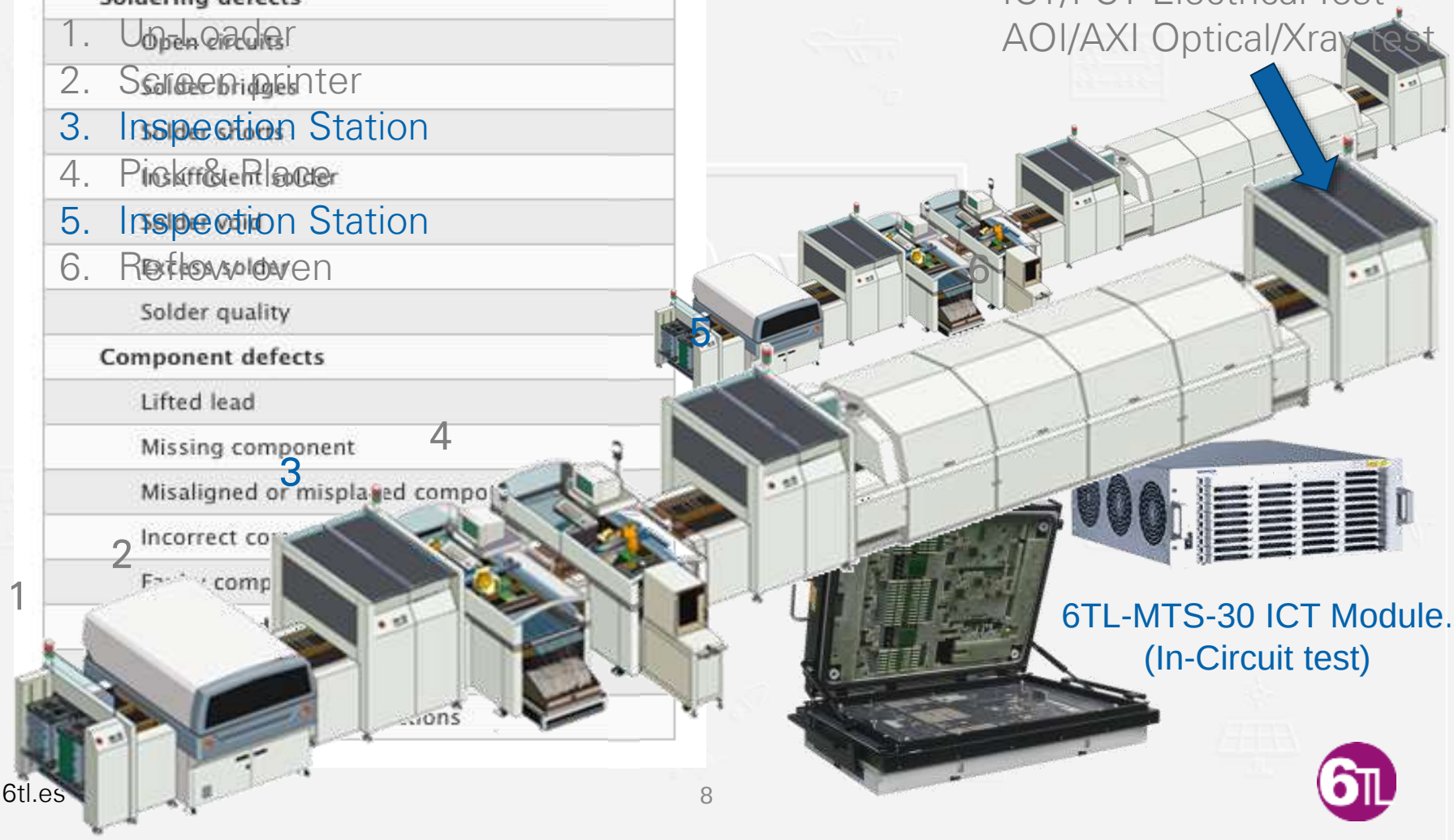
- Terminology explained, ICT, FCT, DFT, DUT, UUT, MIC, *fast*ATE.
  - ICT stands for In-Circuit test.

# Typical SMD production line.

| Defect type | ICT |
|---|---|
| **Soldering defects** | |
| Open circuits | |
| Solder bridges | |
| Insufficient solder | |
| Excess solder | |
| Solder quality | |
| **Component defects** | |
| Lifted lead | |
| Missing component | |
| Misaligned or misplaced compo | |
| Incorrect co | |
| Fa comp | |
| ions | |

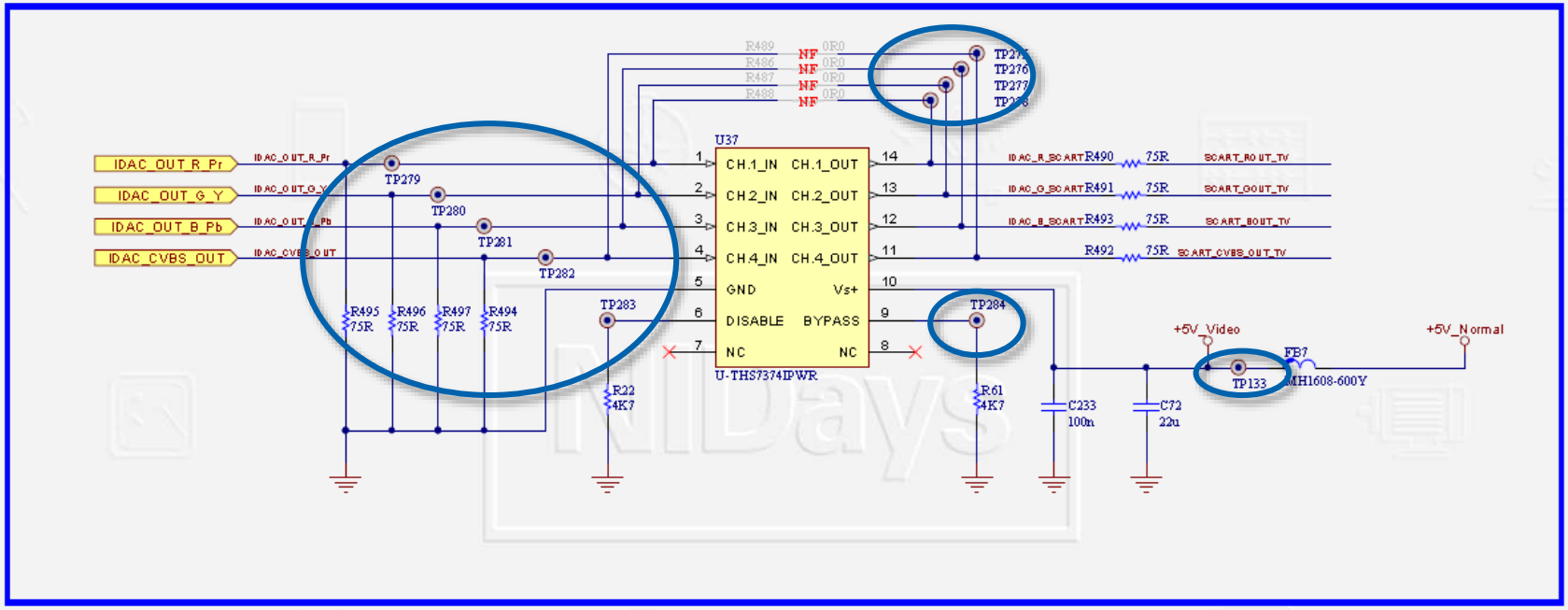
1. Un-Loader
2. Screen printer
3. Inspection Station
4. Pick & Place
5. Inspection Station
6. Reflow oven

7. Inspection Station :
   ICT/FCT Electrical Test
   AOI/AXI Optical/Xray test




6TL-MTS-30 ICT Module.
(In-Circuit test)

# DFT - Design For Test.




Add Test Points for ICT

# What will be covered.

- General terms explained, ICT, FCT, DFT, DUT, UUT, MIC, *fast*ATE.
  - ICT stands for In-Circuit test.
  - FCT stands for Functional test.

# Typical SMD production line.

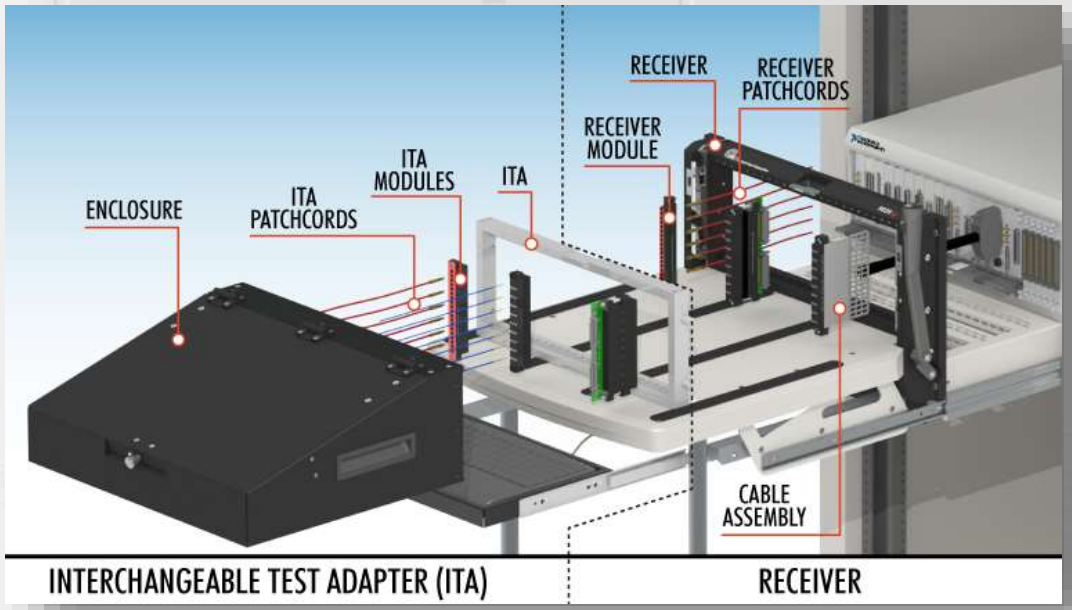
| Defect type | FCT |
|---|---|
| All ICT failures but inaccurate so difficult to trace. | |
| Analog additional testing | |
| Wrong oscillator frequency | |
| Analog signal clipping/distortion | |
| Amplifier gain or bandwidth issues | |
| Drive currents of power output circuits | |
| Potentiometer adjustment issues | |
| | |
| Issues with digital circuitry such as: | |
| Signal timing (design or component related) | |
| Communications problems (Ethernet, DeviceNet, Serial, etc.) | |
| running tests at real speed | |
| Real condition testing | |
| Under climate control | |
| With loads and high power | |
| Push buttons automatically | |
| Annalise data, video, communication etc. | |

6TL-28 FCT Module.
(Functional test)

# What will be covered.

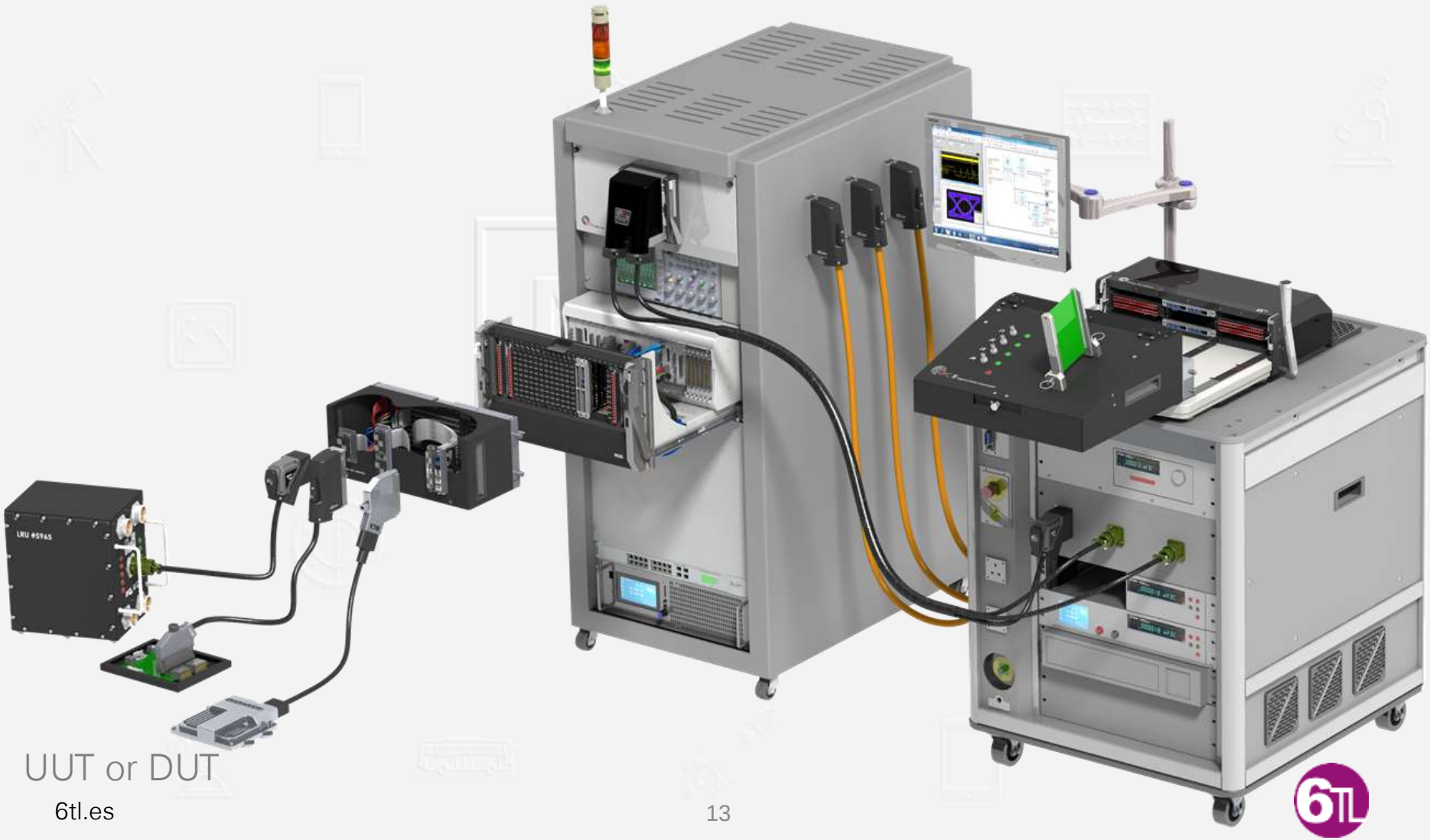
- General terms explained, ICT, FCT, DFT, DUT, UUT, MIC, *fast*ATE.
  - ICT stands for In-Circuit test.
  - FCT stands for Functional test.
  - DFT stands for design for test (Tooling Holes, Test Points, Board Stress)
  - DUT stands for device Under Test - UUT stands for Unit Under Test
  - MIC stand for Mass Interconnect.

## Terminology



# Mass Interconnect Interface.

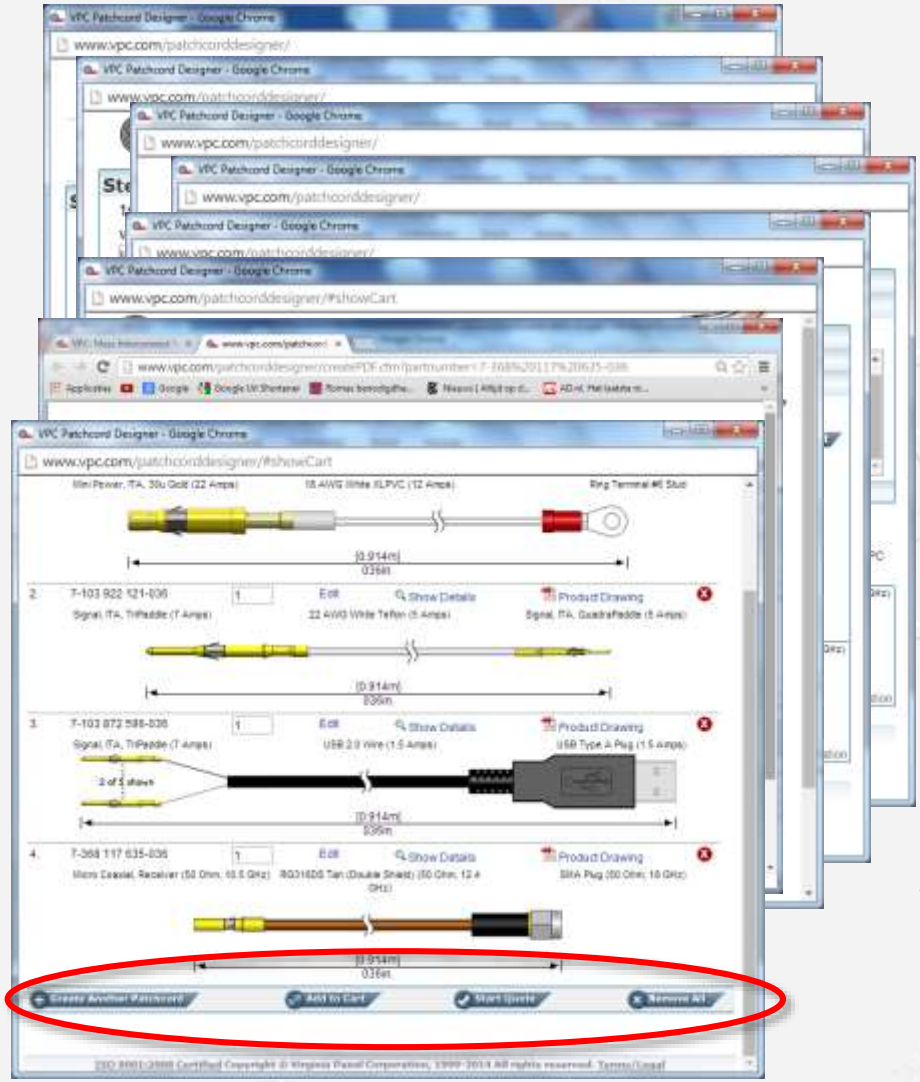
Virginia Panel Corporation



UUT or DUT

# Patchcord designer.

Virginia Panel Corporation





PATCHCORD designer

Wire+ Configurator

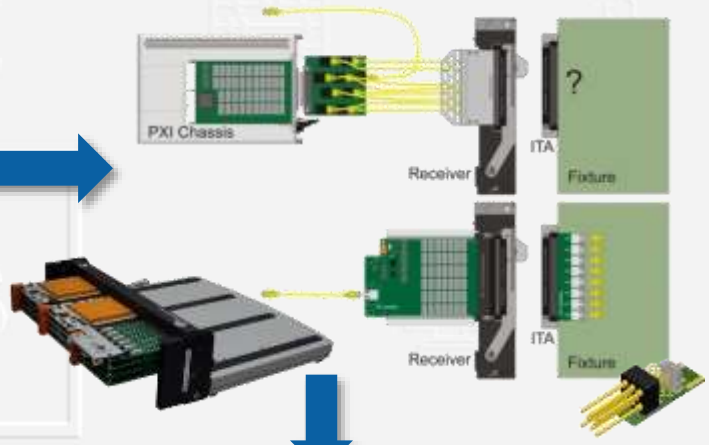
InterConnect Designer

# What will be covered.

- General terms explained, ICT, FCT, DFT, DUT, UUT, MIC, *fast*ATE.
  - ICT stands for In-Circuit test.
  - FCT stands for Functional test.
  - DFT stands for design for test
  - DUT stands for device Under Test - UUT stands for Unit Under Test
  - MIC stand for Mass Interconnect.
  - *fast*ATE is a modular concept developed by 6TL Engineering enabling engineers to build new test systems in record time.
    - Modular
    - Scalable,
    - Flexible,
    - Reliable
    - Future proof
    - Standardized concept (Building Blocks)

# *fast*ATE® technology is Modularity.

## PXI




# What will be covered.

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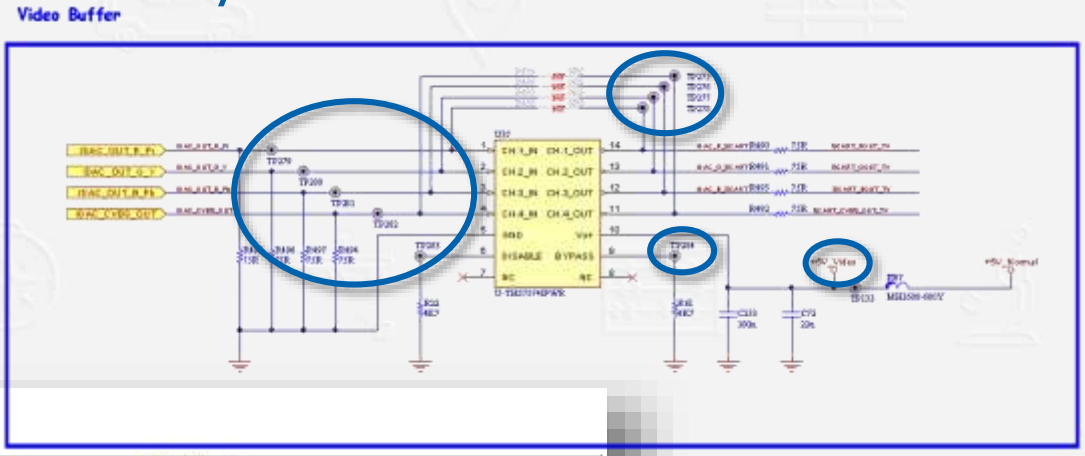
  - After sales services


NIDays 2015

# DFT - Design for testability



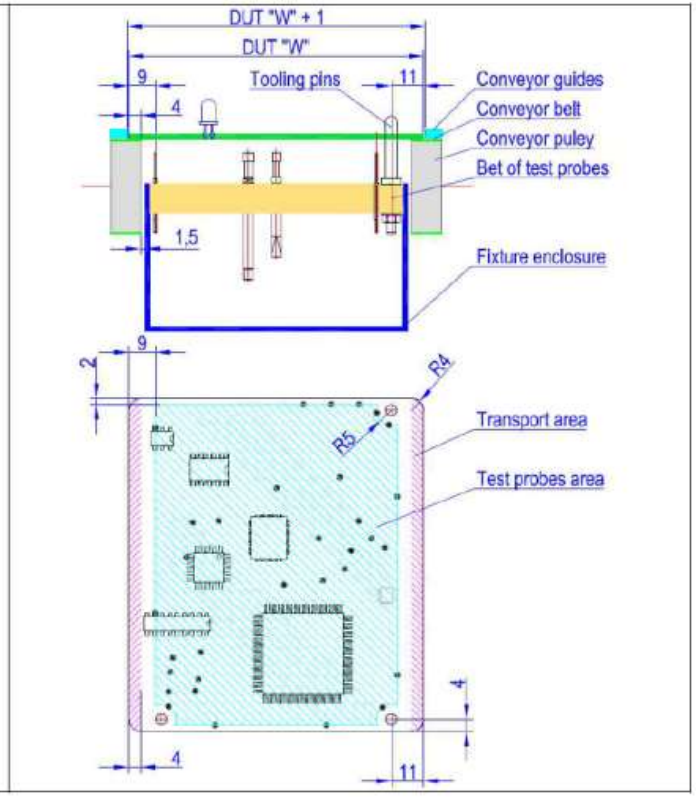

Add Test Points for ICT

## 1.1 Handler Issues

According to SMEMA, transport requires edge clearance on two parallel sides of teh UUT of 4,75mm (0,187”). Best along the longest edges of the UUT to prevent sag.

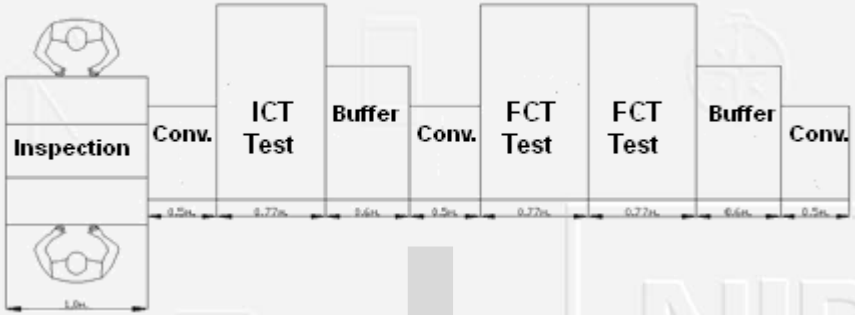
In our systems, mínimum 4mm are required.

In the case with odd shaped boards two solutions exist:
_ Use break away rails that comply with the above
_ Use a custom or universal carrier to move the UUT into the machine.

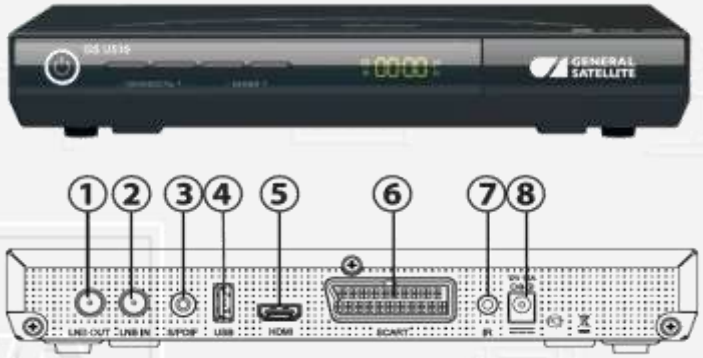


# Specifications.

## Layout




## Product

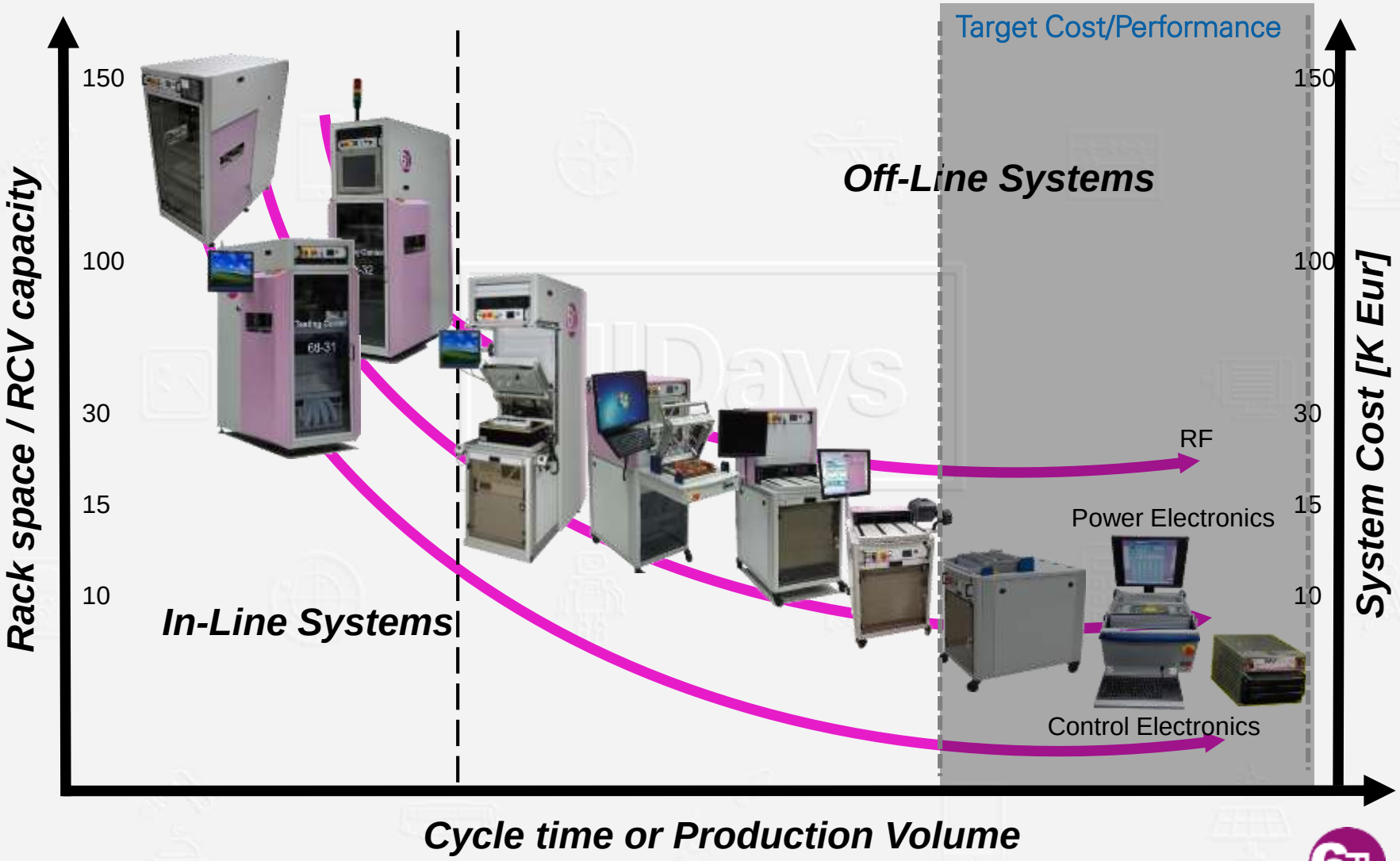



Platform ?

Instrumentation ?

Minimal output of the line 1 product every 50 Seconds.
ICT Tact-time was calculated to be max 20 seconds
FCT Tact-time and programming was +/- 40 seconds

# *fast*ATE® Always the right ***base platform*** for the job.



# 6TL-33

## Main Features

- In-Line test handler
- 3.000N Press down force
- Max PCB size: 350x450mm
- Automatic transport belt width adjustment
- Optional matrix or barcode reader
- Multi-station operation with by-pass
- Handling time: 4s
- Fixture exchange time <1 min
- 24U 19” free rack space
- VPC 9025TR style MIC receiver with 25 slots
- Test rack manager (P/N H71000701)
- TFT, Keyboard and mouse inside or outside on a height adjustable support
- UPS 1000VA

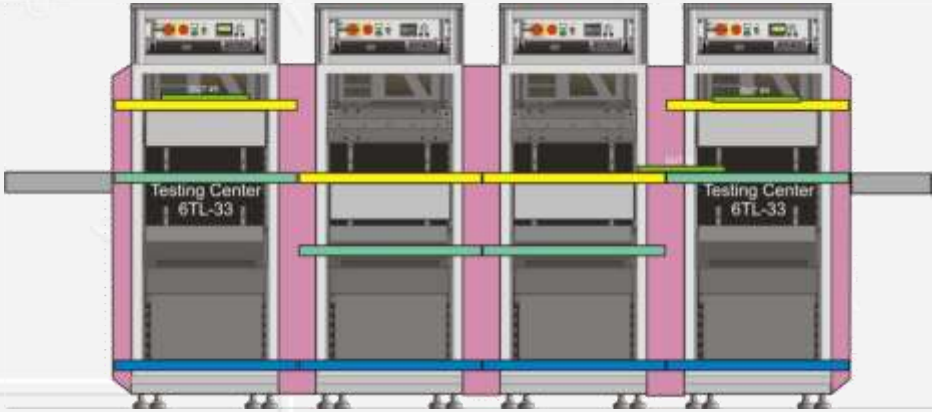
# 6TL-33 Modularity

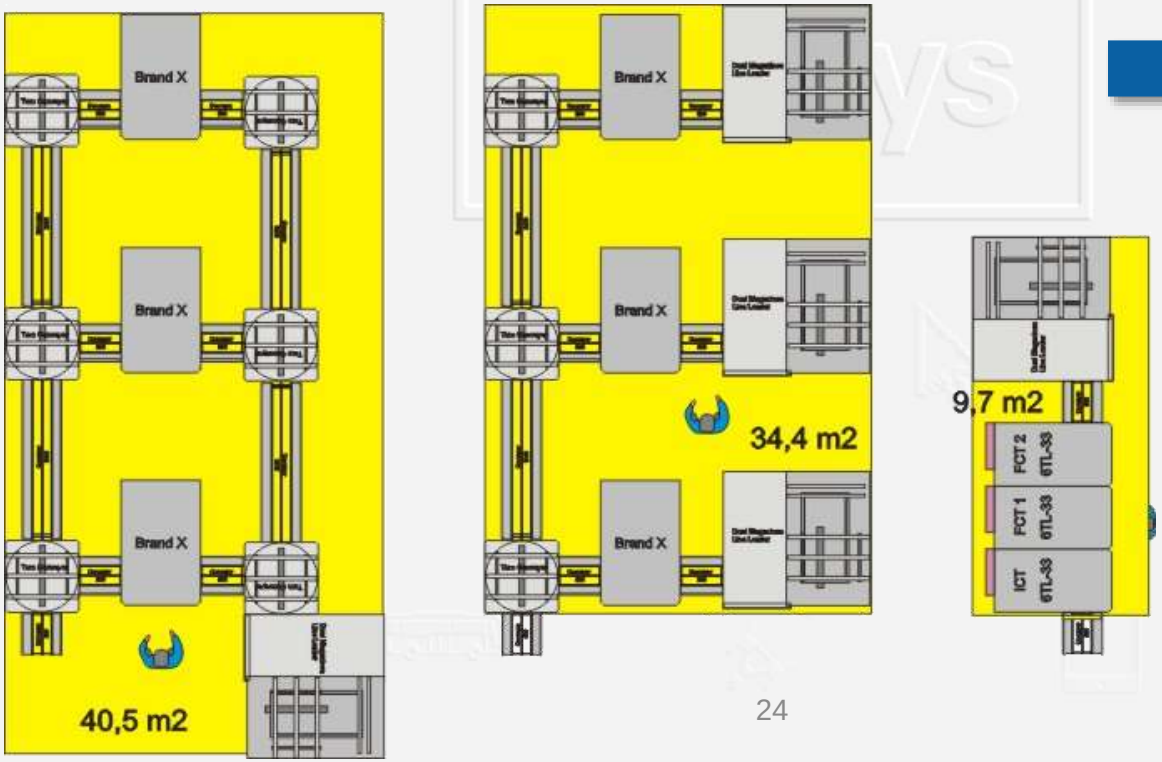
- Independent modules
- Working as a team
- With edless possibilities



# 6TL-33 Optional Bypass conveyor.

- Bypass conveyor
  - Reduced factory Floor space >75%
  - Optimizes the loading process

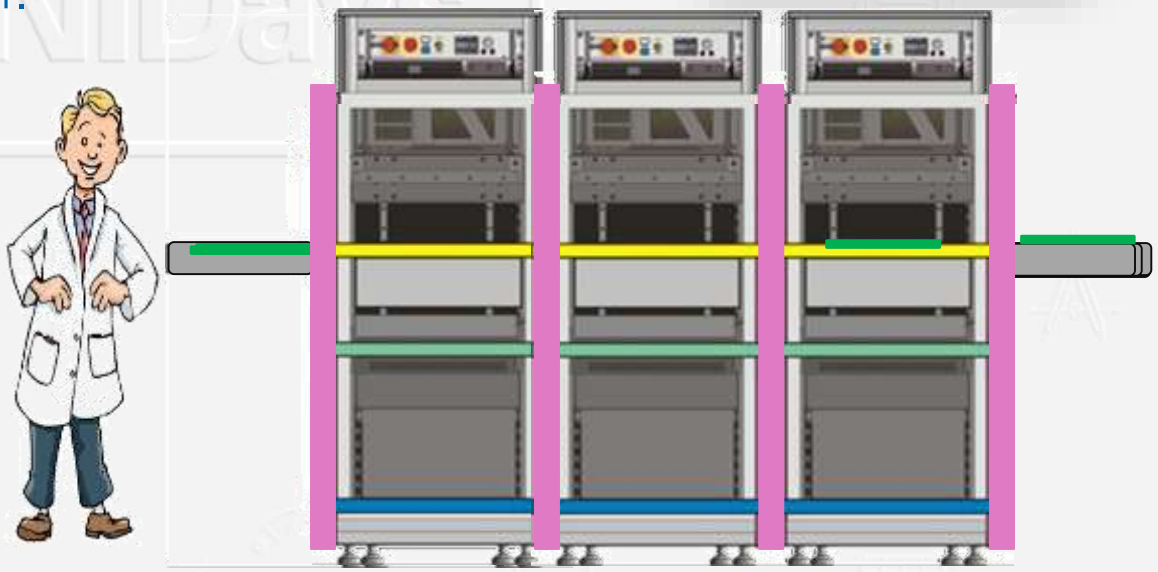


# Space saving bypass

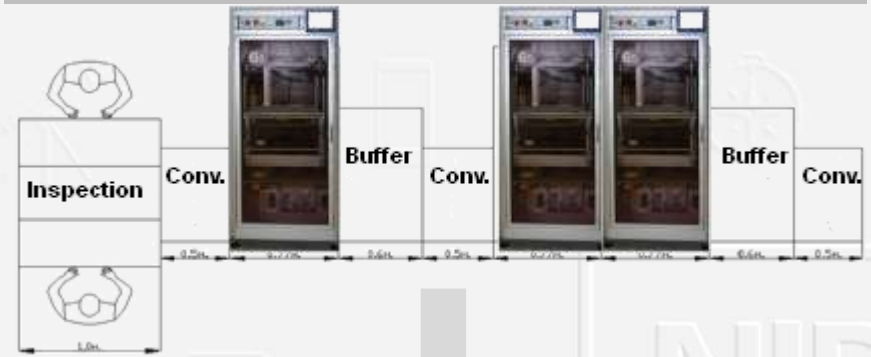
Optimal production cycle example (3x equal test)

1. Pass Through  (No testing)
2. Load station 3, move into test position, start test.
3. Load station 2, move into test position, start test.
4. Load station 1, move into test position, start test.
5. Station 3 test finished, unload and reload.
6. Optional Return conveyor.

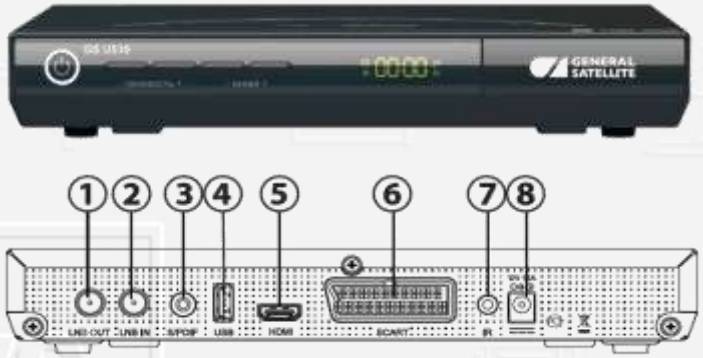


# Specifications.

## Layout




## Product



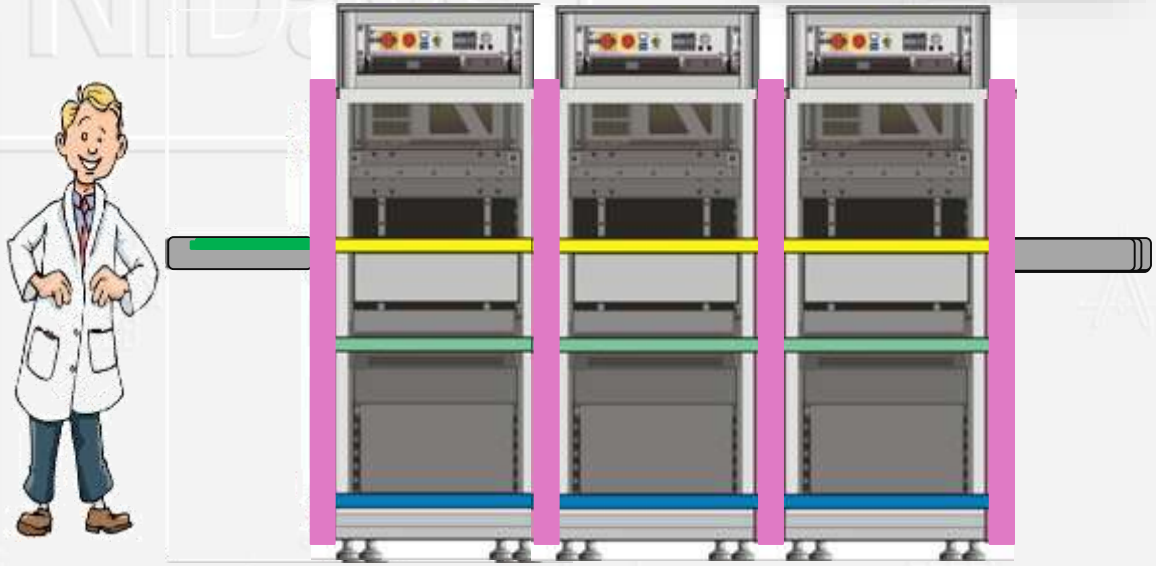

Platform 6TL233

ICT Tact-time was calculated to be max 20 seconds
FCT Tact-time and programming was +/- 40 seconds
Minimal output of the line: 1 product every 50 Seconds.

# Space saving bypass

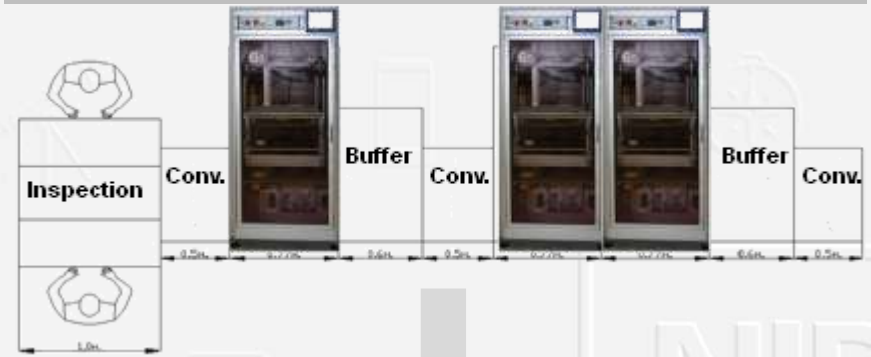
## Optimal production cycle example

1. ICT(1-20s) if pass Move to (3-40s) FCT/Programming
2. ICT(1-20s) if pass Move to (2-40s) FCT/Programming
   - Unload (3-40s) FCT/Programming = Pass/Fail
3. ICT(1-20s) if pass Move to (3-40s) FCT/Programming
   - Unload (2-40s) FCT/Programming = Pass/Fail
4. Etc. one every 20s + (handling) = 30s a board is tested.
5. Handler software works, in the basis, like with 3 elevators

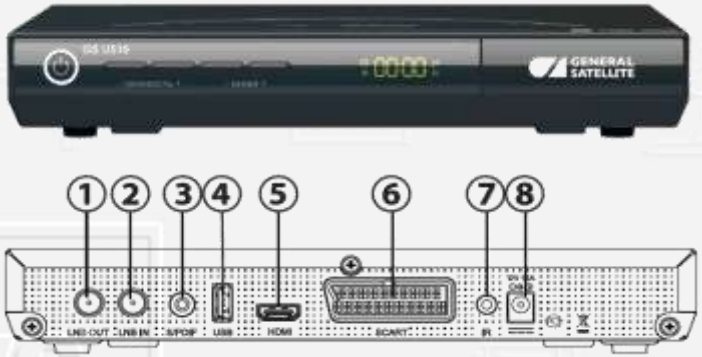


# Specifications.

## Layout




## Product



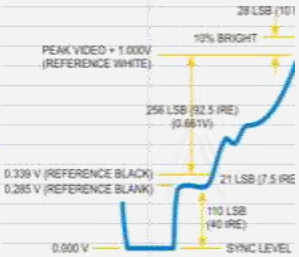

Platform 6TL-33

Instrumentation ?

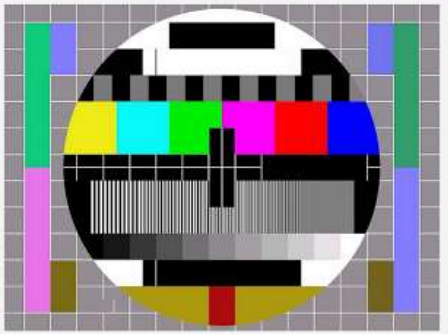
ICT Tact-time was calculated to be max 20 seconds
FCT Tact-time and programming was +/- 40 seconds
Minimal output of the line: 1 product every 50 Seconds.

# Consultancy towards instrumentation

| | Item | Description | Target | Range | TP | K | Instrument | Time | Area checked |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Provide power 12V to cn | | 12 | 5% | TP104 | | PSU | | |
| 2 | Set factory mode ON | Disable blankings, mutes, OSD | - | - | TP65, TP66 | | UART COMMAND | | |
| 3 | Power Levels 12V in | Check Voltage level | 12 | 5% | TP104 | | DMM | | |
| 4 | Power Levels 5V | Check Voltage level | 5 | 5% | TP106 | | DMM | | |
| 5 | Power Levels 5V STBY | Check Voltage level | 5 | 5% | TP107 | | DMM | | |
| 6 | Power Levels 3V3 | Check Voltage level | 3,3 | 5% | TP105 | | DMM | | |
| 7 | Power Levels 3V3 STBY | Check Voltage level | 3,3 | 5% | TP108 | | DMM | | |
| 8 | Power Levels 1V3 | Check Voltage level | 1,3 | 5% | TP109 | | DMM | | |
| 9 | Power Levels 1V5 | Check Voltage level | 1,5 | 5% | TP112 | | DMM | | |
| 10 | Power consumption | Check power consumption | TBD (xx A) | 5% | - | | DMM | | |
| 11 | | Set STBY MODE 1 | - | - | TP65, TP66 | | UART COMMAND | | |
| 12 | | Check power consumption | TBD (xx A) | 5% | - | | DMM | | |
| 13 | | Set STBY MODE 2 | - | - | TP65, TP66 | | UART COMMAND | | |
| 14 | | Check power consumption | TBD (xx A) | 5% | - | | DMM | | |
| 15 | | Set NORMAL MODEL | - | - | TP65, TP66 | | UART COMMAND | | |
| 16 | SCART RGB Out | Generate Color Bar 100% 576i50Hz with internal OSD. (Macrovision must be disabled) | - | - | TP65, TP66 | | UART COMMAND | | |
| 17 | | Check timing format | 576i50Hz | - | TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 18 | | Check line 100 individual W bar level. | R 100% G 100% B 100% | 2% | TP127, TP128, TP130 (RGB) TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 19 | | Check line 100 individual R bar level. | R 100% G 0% B 0% | 2% | TP127, TP128, TP130 (RGB) TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 20 | | Check line 100 individual G bar level. | R 0% G 100% B 0% | 2% | TP127, TP128, TP130 (RGB) TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 21 | | Check line 100 individual B bar level. | R 0% G 0% B 100% | 2% | TP127, TP128, TP130 (RGB) TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 22 | | Check line 100 individual Y bar level. | R 100% G 0% B 100% | 2% | TP127, TP128, TP130 (RGB) TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 23 | | Check line 100 individual C bar level. | R 100% G 100% B 0% | 2% | TP127, TP128, TP130 (RGB) TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 24 | | Check line 100 individual M bar level. | R 0% G 100% B 100% | 2% | TP127, TP128, TP130 (RGB) TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 25 | | Check line 100 individual BLACK bar level. | R 0% G 0% B 0% | 2% | TP127, TP128, TP130 (RGB) TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 26 | | Generate Multiburst signal (6 bursts) or sweep | - | - | TP65, TP66 | | UART COMMAND | | |
| 27 | | Check frequency distortion/levels | 100% | 5% | TP127, TP128, TP130 (RGB) TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 28 | SCART CVBS Out | Generate Color Bar 100% 576i50Hz with internal OSD. (Macrovision must be disabled) | - | - | TP65, TP66 | | UART COMMAND | | |
| 29 | | Check timing format | 576i50Hz | | TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 30 | | Check Color Burst frequency | 4.43361875 MHz (PAL) | 1% | TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 31 | | Check Color Burst level | 20 IRE | 20% | TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 32 | | Check Hsync level | -40 IRE | 20% | TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 33 | | Check line 100 individual W bar level. | 100 IRE | 1% | TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 34 | | Check line 100 individual BLACK bar level. | 0 IRE | 1% | TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 35 | | Generate Multiburst signal (6 bursts) or sweep | - | - | TP65, TP66 | | UART COMMAND | | |
| 36 | | Check frequency distortion/levels | 100% | 5% | TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 37 | SCART Mode Out | Disable format screen. | - | - | TP65, TP66 | | UART COMMAND | | |
| 38 | | Check voltage | 1V | 100% | TP129 | | DMM | | |
| 39 | | Generate 16:9 format screen. | - | - | TP65, TP66 | | UART COMMAND | | |
| 40 | | Check voltage | 6V | 30% | TP129 | | DMM | | |
| 41 | | Generate 4:3 format screen. | - | - | TP65, TP66 | | UART COMMAND | | |
| 42 | | Check voltage | 11V | 15% | TP129 | | DMM | | |
| 43 | SCART Blanking Out | Enable blanking (RGB). | - | - | TP65, TP66 | | UART COMMAND | | |
| 44 | | Check voltage | 2V | 50% | TP126, TP125 (CVBS) | | DMM | | |
| 45 | | Disable blanking (CVBS). | - | - | TP65, TP66 | | UART COMMAND | | |
| 46 | | Check voltage | 0,2V | 100% | TP126, TP125 (CVBS) | | DMM | | |
| 47 | | Generate Multiburst signal (6 bursts) or sweep. | - | - | TP65, TP66 | | UART COMMAND | | |
| 48 | | Check frequency distortion/levels | 100% | 5% | TP126, TP125 (CVBS) | | WAVEFORM ANALYZER | | |
| 49 | SCART Audio Out | Generate 1kHz (L) - 1.5kHz (R) 100% audio level. Check Voltage level | - | - | TP65, TP66 | | UART COMMAND | | |

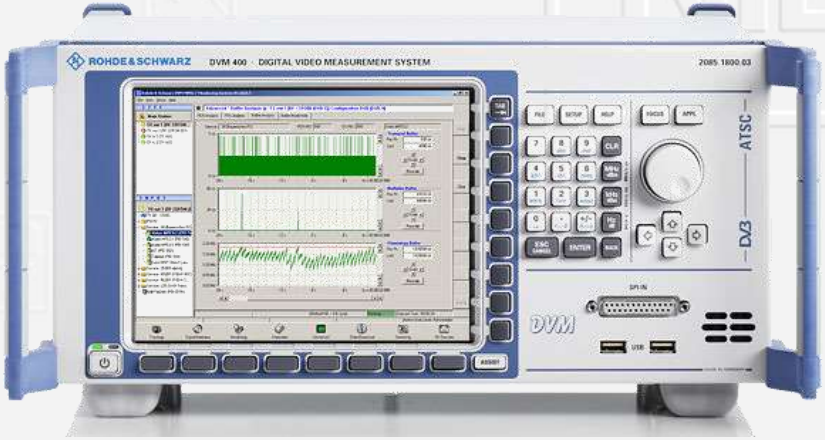


# Consultancy towards instrumentation



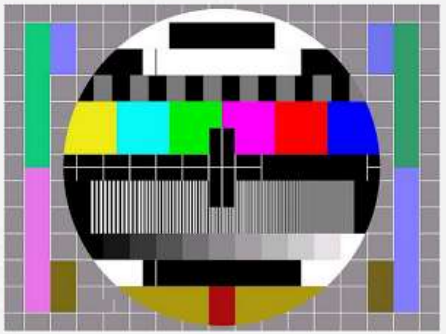
## Alternatives

- R&S®DVM400 Digital Video Measurement System




- Pros
  - High performance
  - Versatility
- Cons
  - Complicated integration
  - High price
  - Over dimensioned functions

# Consultancy towards instrumentation

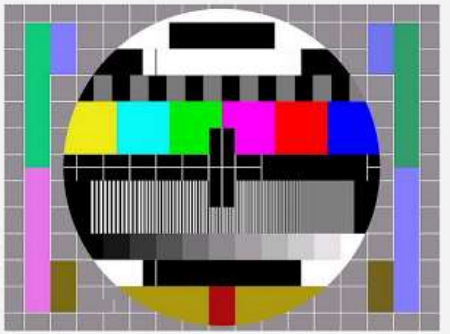


## Alternatives

- RT-AV100/101

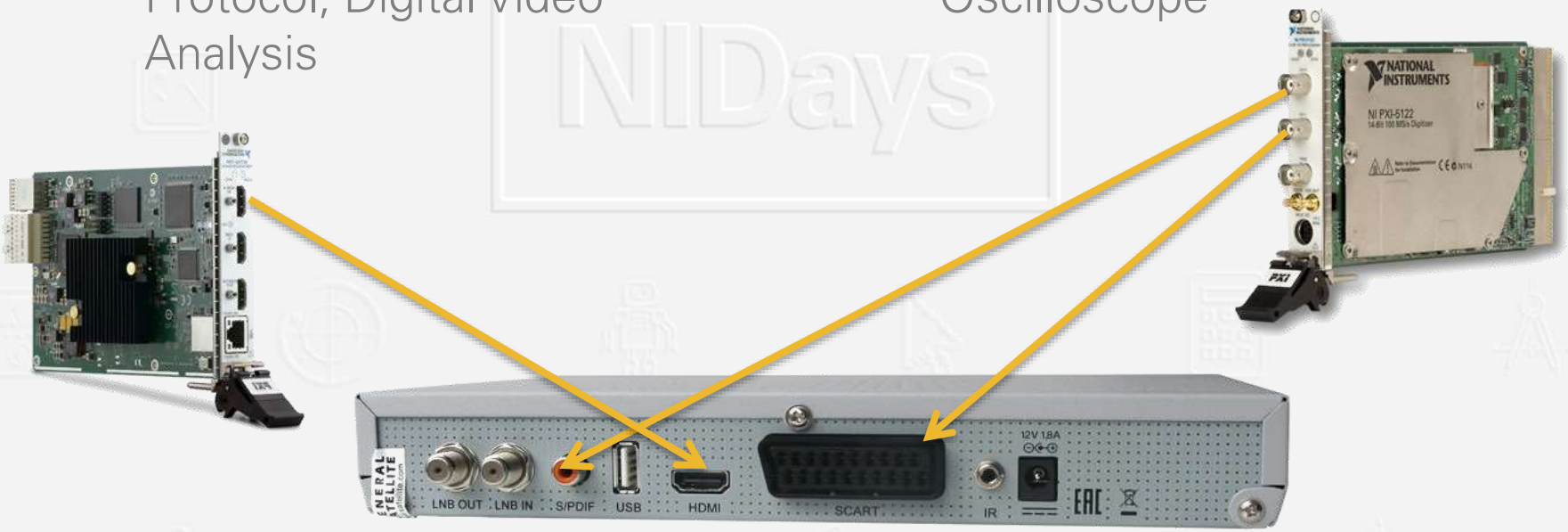
- Pros
  - All-in-one
  - Competitive price
- Cons
  - Long cycle time (Slow)
  - Not flexible, Closed software
  - Support only local

# Consultancy towards instrumentation

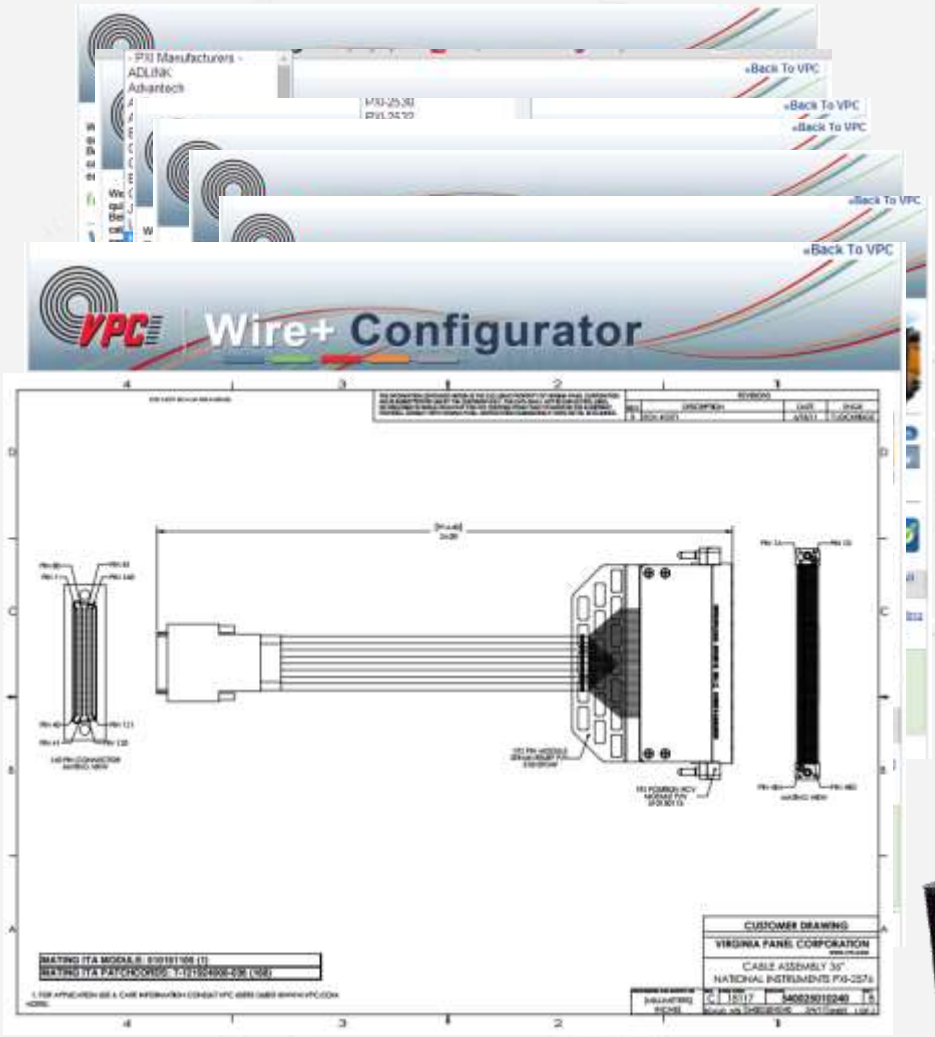


## Winner NI Hardware

- NI PXIe-1491
  - HDMI and Mobile Protocol, Digital Video Analysis
- NI PXI-5124
  - 100 MS/s, 14-Bit Digitizer/ Oscilloscope



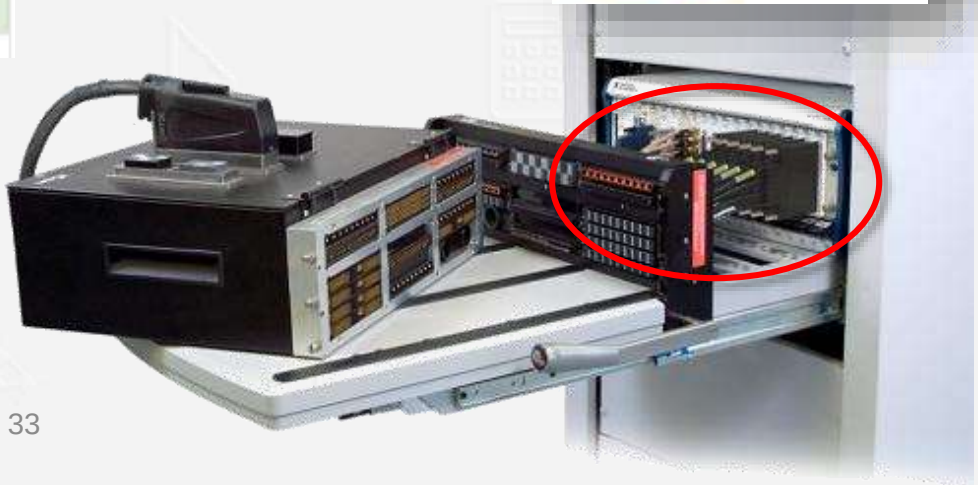
# *fast*ATE® is Reliability with VPC Virginia Panel Corporation




PATCHCORD designer

Wire+ Configurator

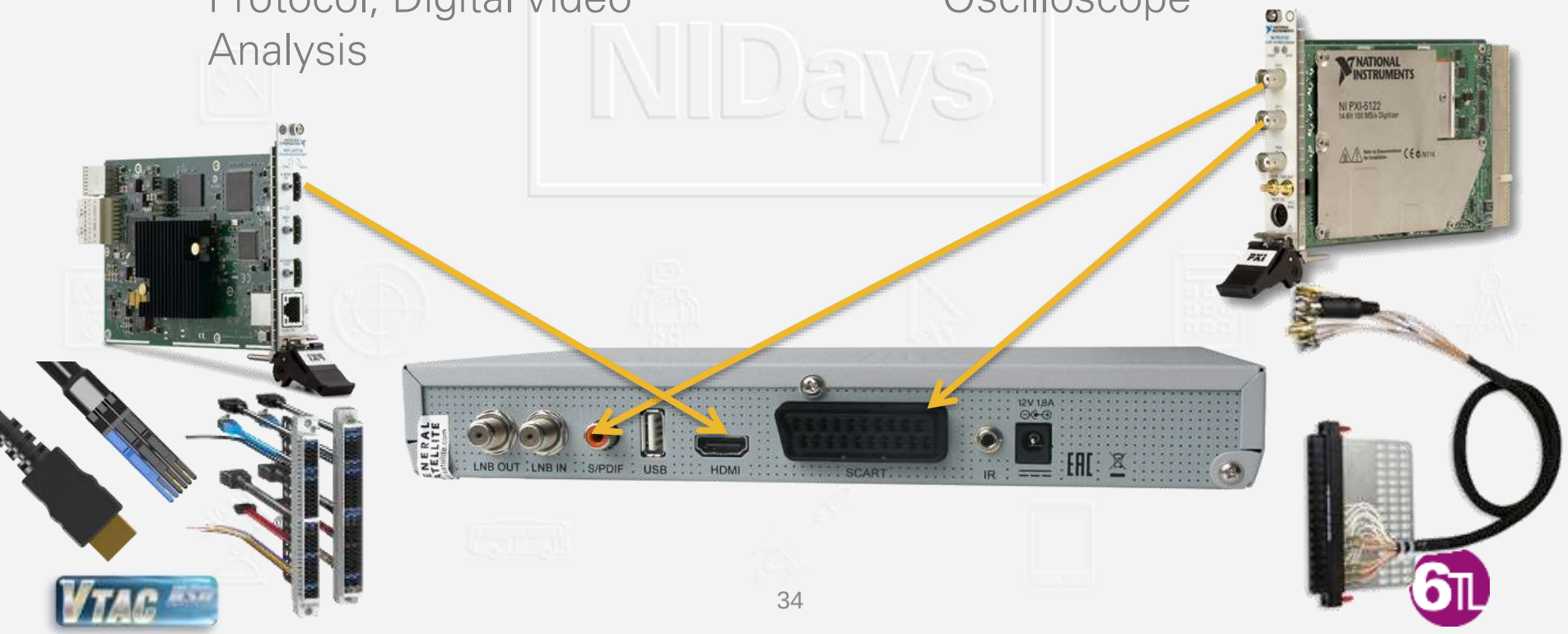
InterConnect Designer



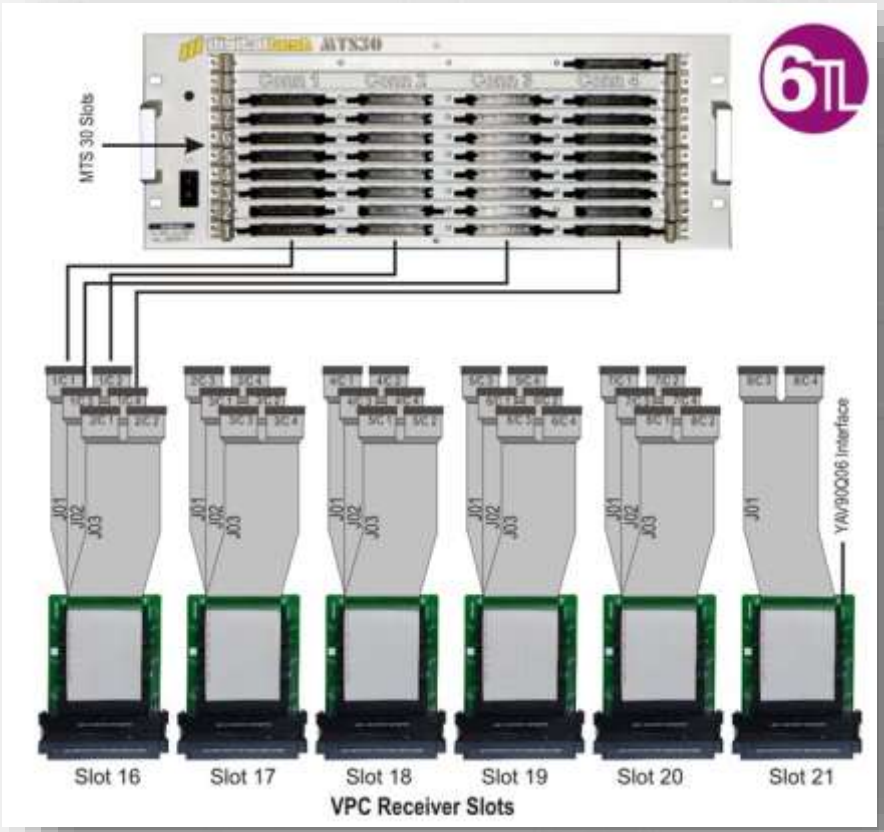
# Consultancy towards instrumentation

## Winner NI Hardware

- NI PXIe-1491
  - HDMI and Mobile Protocol, Digital Video Analysis
- NI PXI-5124
  - 100 MS/s, 14-Bit Digitizer/ Oscilloscope



# ICT Module


MTS 30 Slots
Slot 16
Slot 17
Slot 18
Slot 19
Slot 20
Slot 21
VPC Receiver Slots

# Quotation and Order received.

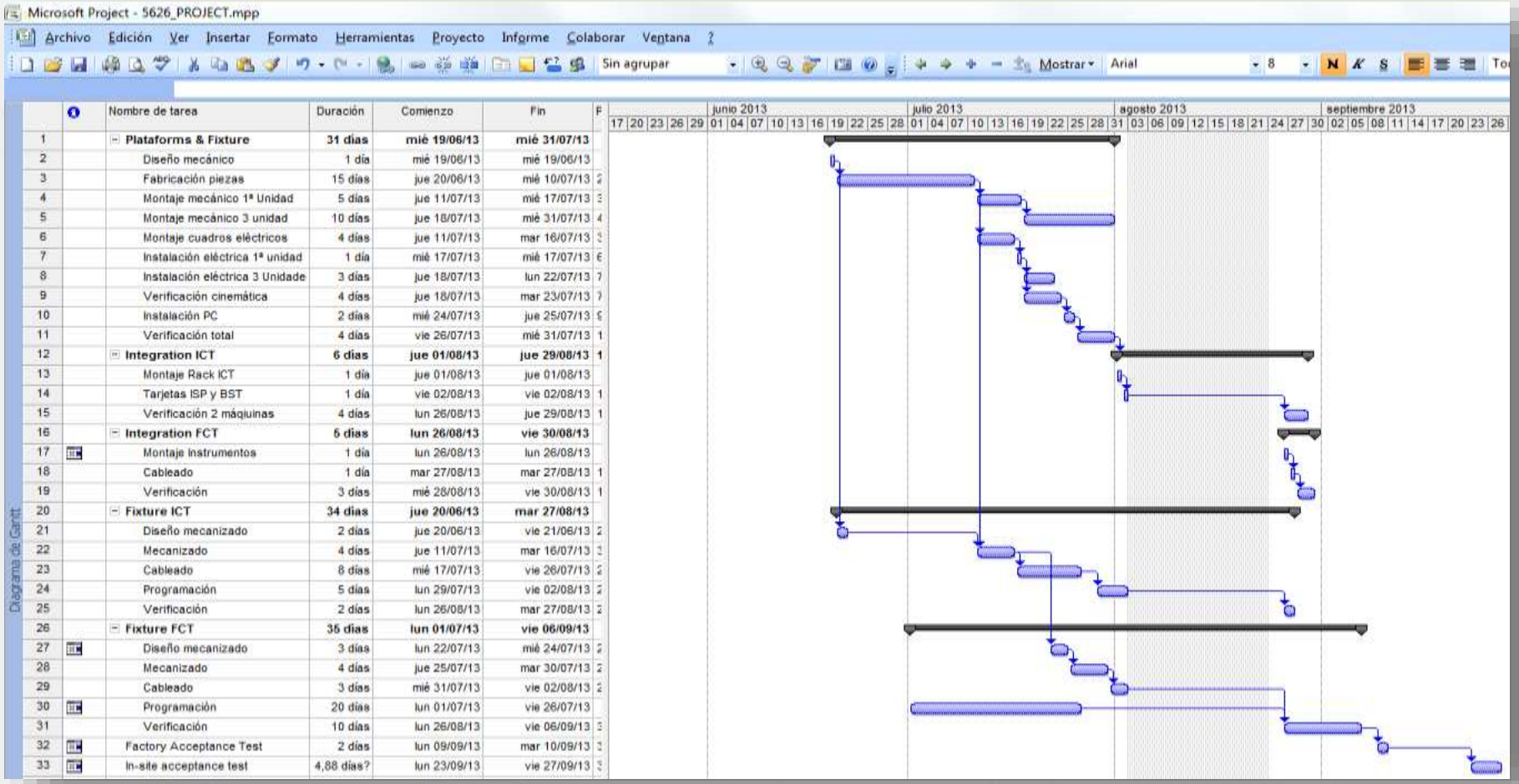
P.O.

NIDays

I need it,
I've paid,
I Want it
Tomorrow !!!!!

# Quotation and Order received.

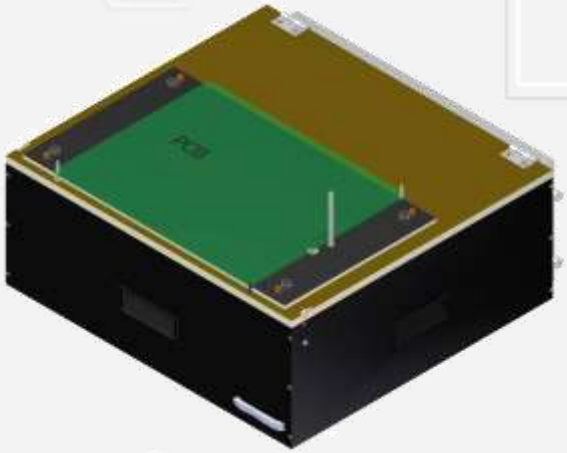
## *fast*ATE® enabled us a realisation time off 6 weeks.

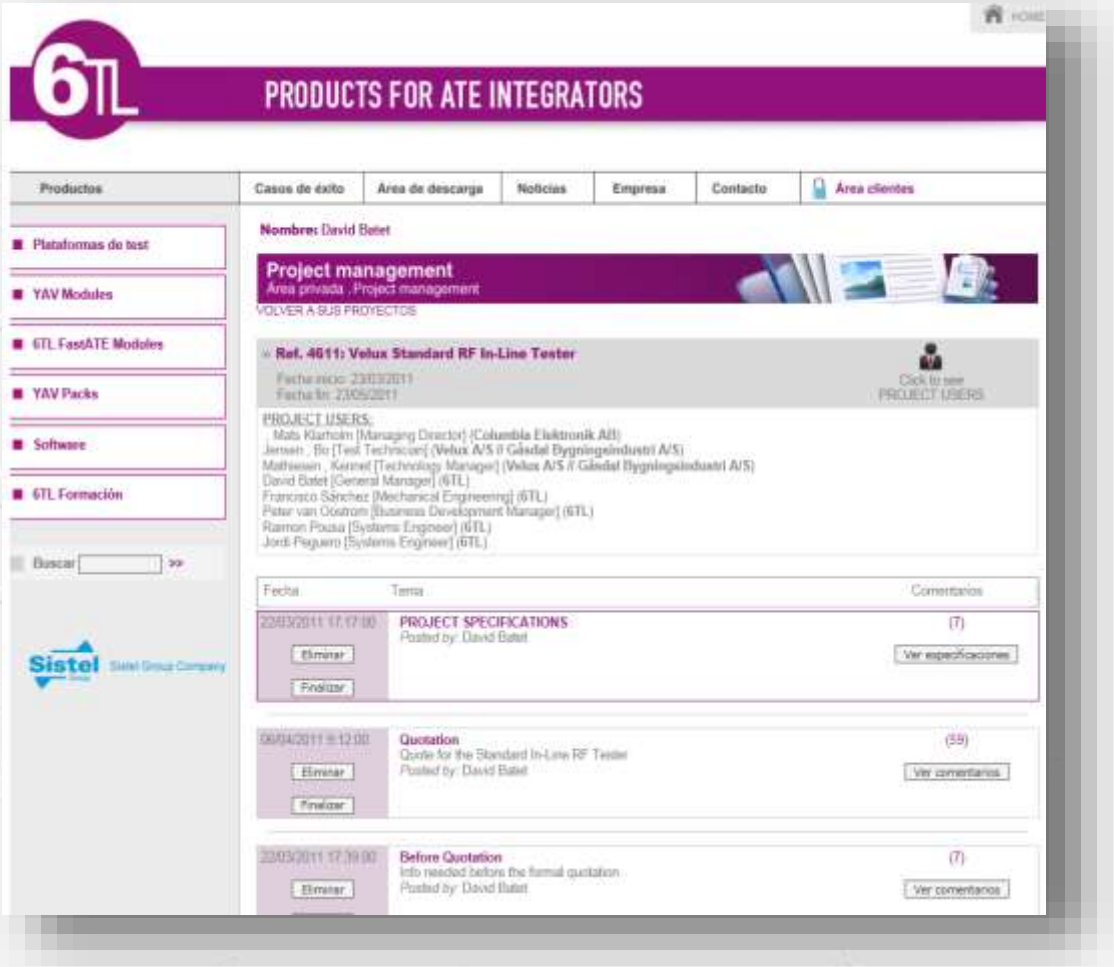



| | Nombre de tarea | Duración | Comienzo | Fin |
|---|---|---|---|---|
| 1 | **Plataforms & Fixture** | **31 días** | **mié 19/06/13** | **mié 31/07/13** |
| 2 | Diseño mecánico | 1 día | mié 19/06/13 | mié 19/06/13 |
| 3 | Fabricación piezas | 15 días | jue 20/06/13 | mié 10/07/13 |
| 4 | Montaje mecánico 1ª Unidad | 5 días | jue 11/07/13 | mié 17/07/13 |
| 5 | Montaje mecánico 3 unidad | 10 días | jue 18/07/13 | mié 31/07/13 |
| 6 | Montaje cuadros eléctricos | 4 días | jue 11/07/13 | mar 16/07/13 |
| 7 | Instalación eléctrica 1ª unidad | 1 día | mié 17/07/13 | mié 17/07/13 |
| 8 | Instalación eléctrica 3 Unidade | 3 días | jue 18/07/13 | lun 22/07/13 |
| 9 | Verificación cinemática | 4 días | jue 18/07/13 | mar 23/07/13 |
| 10 | Instalación PC | 2 días | mié 24/07/13 | jue 25/07/13 |
| 11 | Verificación total | 4 días | vie 26/07/13 | mié 31/07/13 |
| 12 | **Integration ICT** | **6 días** | **jue 01/08/13** | **jue 29/08/13** |
| 13 | Montaje Rack ICT | 1 día | jue 01/08/13 | jue 01/08/13 |
| 14 | Tarjetas ISP y BST | 1 día | vie 02/08/13 | vie 02/08/13 |
| 15 | Verificación 2 máquinas | 4 días | lun 26/08/13 | jue 29/08/13 |
| 16 | **Integration FCT** | **5 días** | **lun 26/08/13** | **vie 30/08/13** |
| 17 | Montaje Instrumentos | 1 día | lun 26/08/13 | lun 26/08/13 |
| 18 | Cableado | 1 día | mar 27/08/13 | mar 27/08/13 |
| 19 | Verificación | 3 días | mié 28/08/13 | vie 30/08/13 |
| 20 | **Fixture ICT** | **34 días** | **jue 20/06/13** | **mar 27/08/13** |
| 21 | Diseño mecanizado | 2 días | jue 20/06/13 | vie 21/06/13 |
| 22 | Mecanizado | 4 días | jue 11/07/13 | mar 16/07/13 |
| 23 | Cableado | 8 días | mié 17/07/13 | vie 26/07/13 |
| 24 | Programación | 5 días | lun 29/07/13 | vie 02/08/13 |
| 25 | Verificación | 2 días | lun 26/08/13 | mar 27/08/13 |
| 26 | **Fixture FCT** | **35 días** | **lun 01/07/13** | **vie 06/09/13** |
| 27 | Diseño mecanizado | 3 días | lun 22/07/13 | mié 24/07/13 |
| 28 | Mecanizado | 4 días | jue 25/07/13 | mar 30/07/13 |
| 29 | Cableado | 3 días | mié 31/07/13 | vie 02/08/13 |
| 30 | Programación | 20 días | lun 01/07/13 | vie 26/07/13 |
| 31 | Verificación | 10 días | lun 26/08/13 | vie 06/09/13 |
| 32 | Factory Acceptance Test | 2 días | lun 09/09/13 | mar 10/09/13 |
| 33 | In-site acceptance test | 4,88 días? | lun 23/09/13 | vie 27/09/13 |

# Communication

- Project Management tool
- Effective communication.

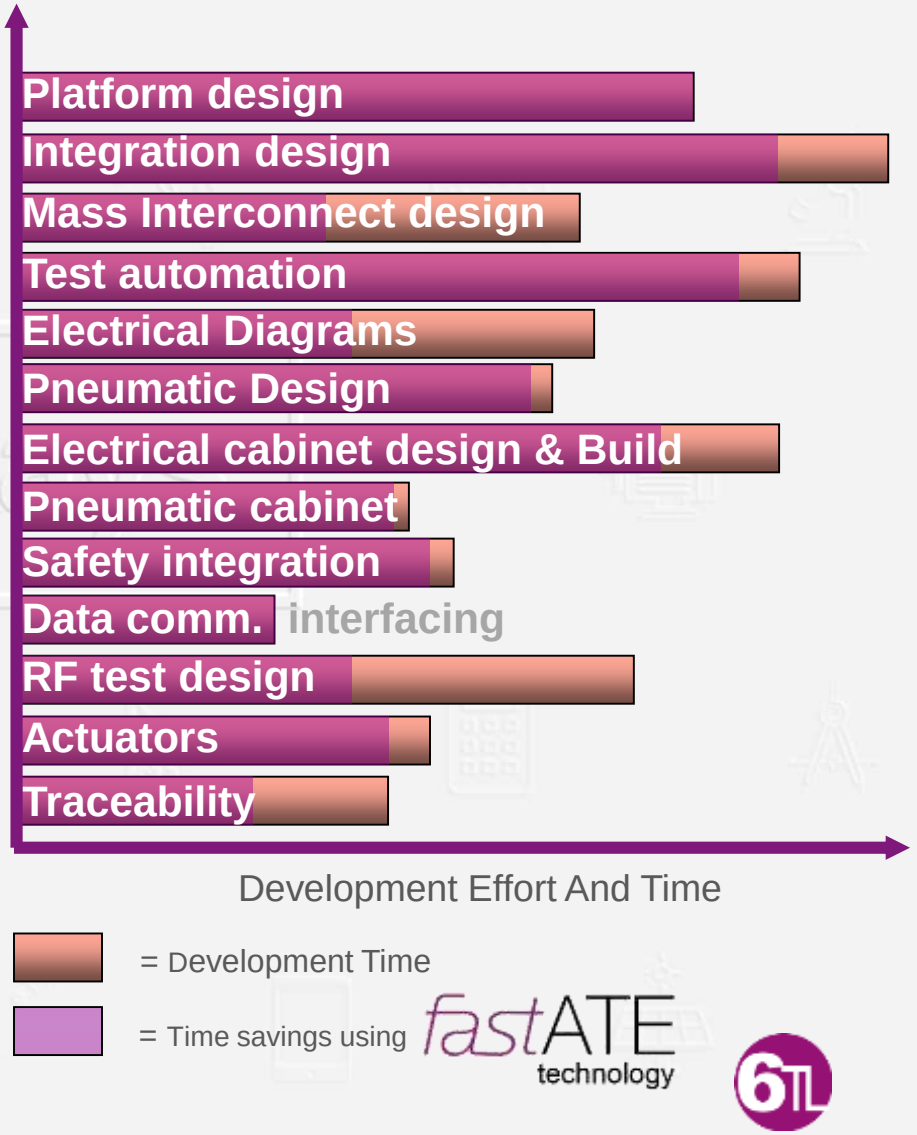




# *fast*ATE® a concept with benefits?

- Thanks to our modules, additional Engineering is reduced to a minimum, so that the test engineer can reduce time on each and every step he needs to cover to complete his turn-key test solution.

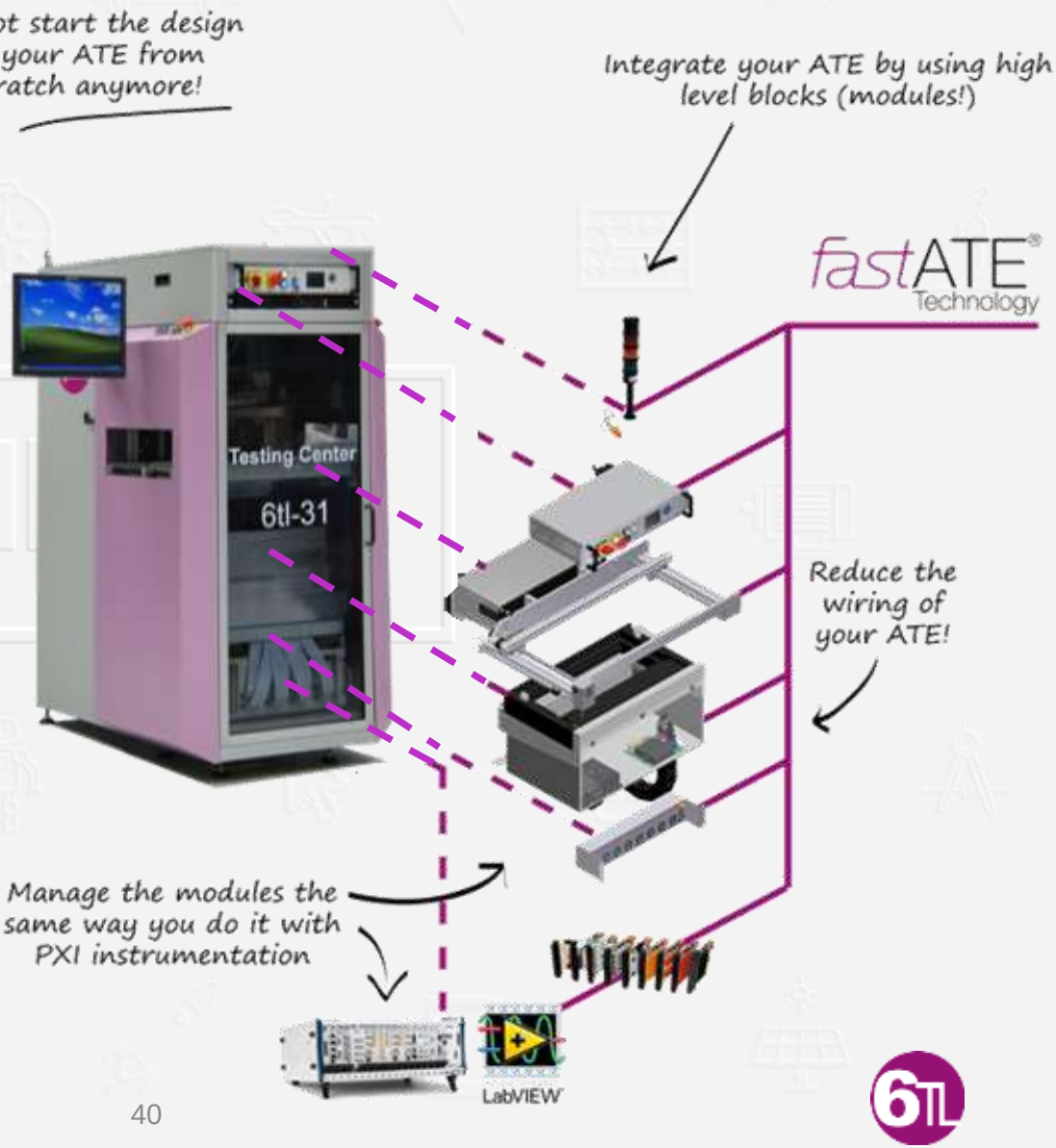
- We provide LabVIEW and TestStand drivers, Direct Can or DLL's drivers to control, set-up and maintain the entire tester architecture.



# *fast*ATE® technology in use.

## How?

1) Choose a Base platform (In-, Off-Line, Table top)
2) Add 6TL Modules to customize the selected Base Test Platform.
3) Add the needed (PXI) instrumentation.
4) Define MIC Interface and cabling solutions.
5) Control the whole test system with LabVIEW over CanBus.



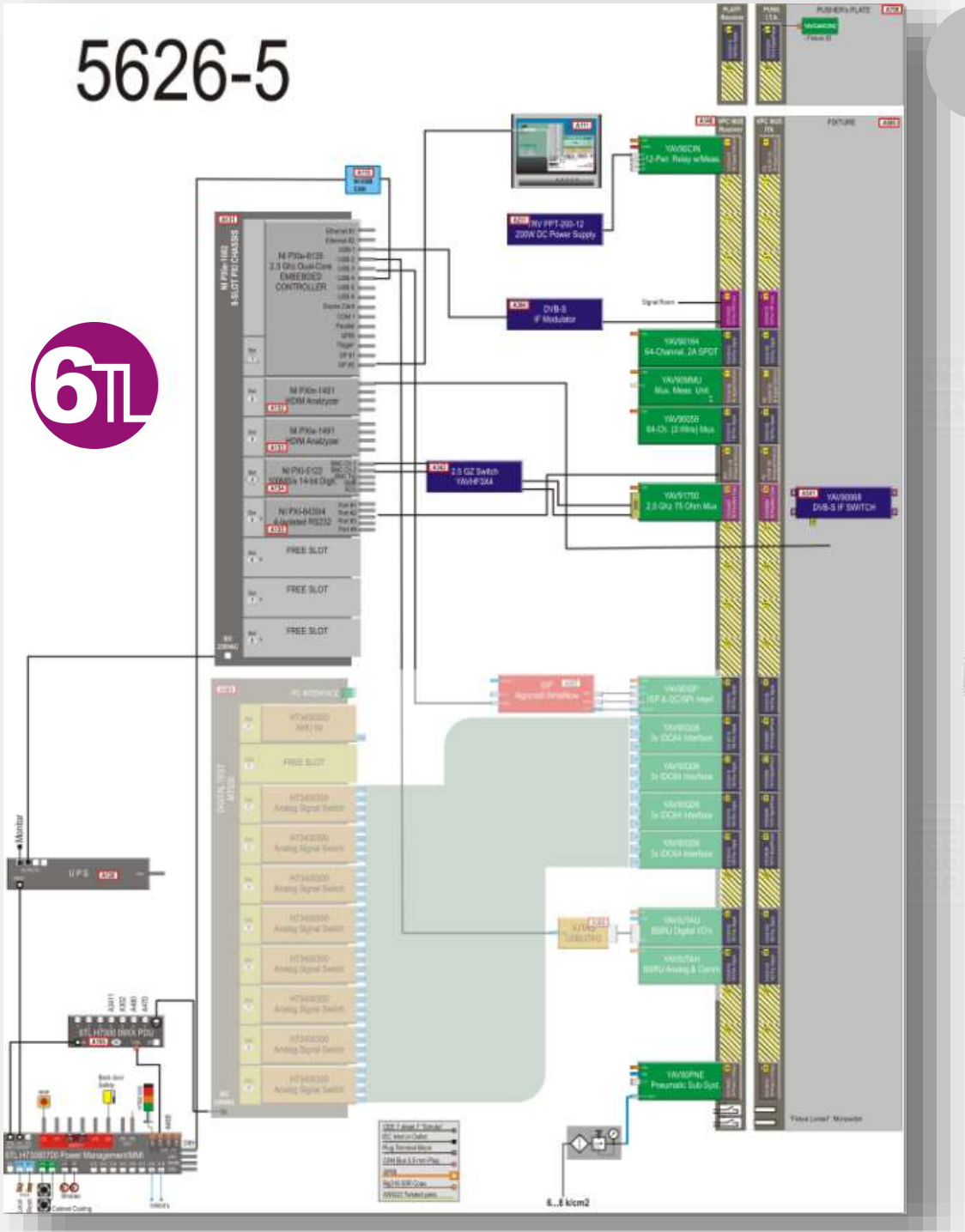
# development

## FCT

## ICT

## Rack control

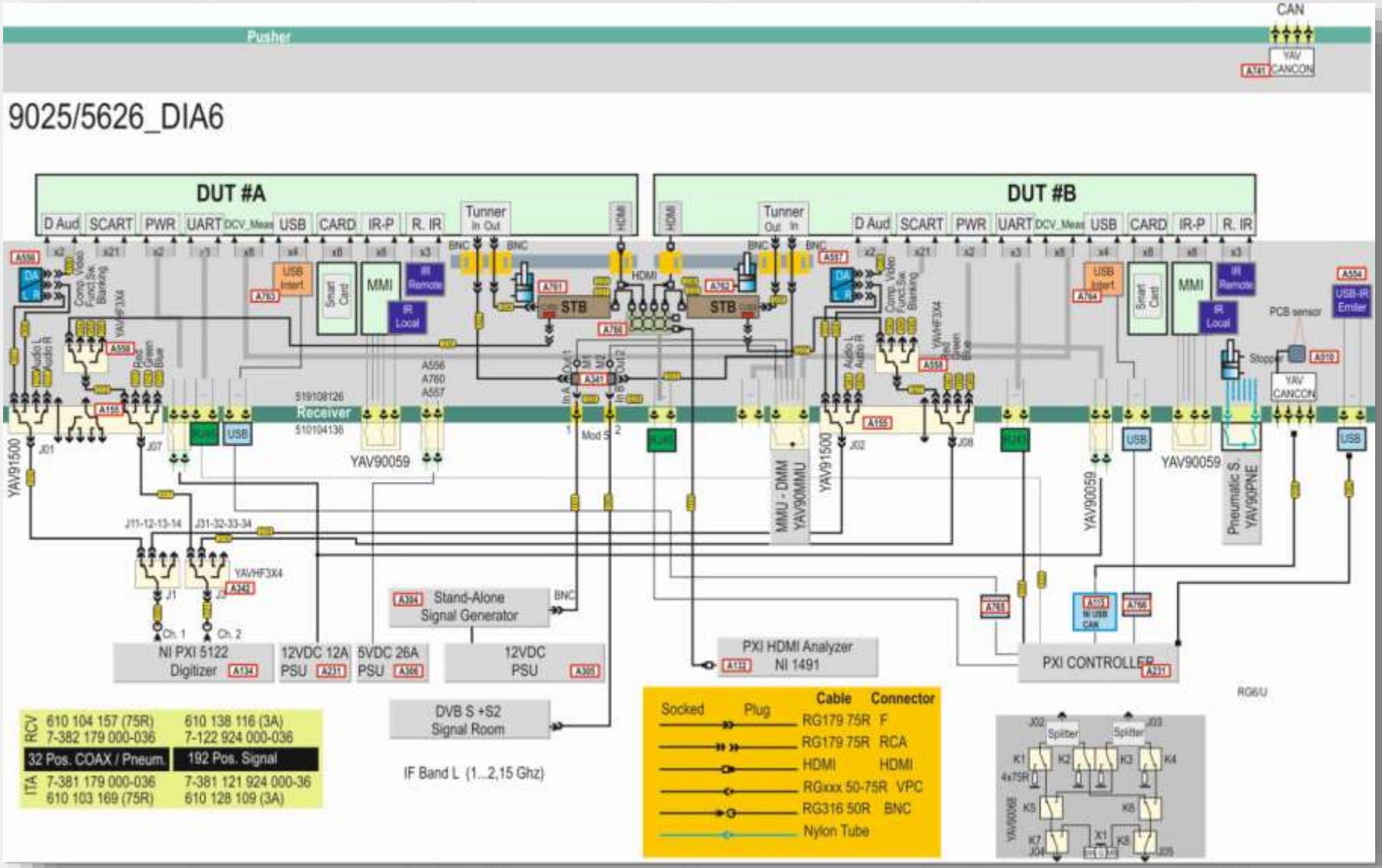
6tl.es




MIC interface config. is equal in all 3 modules for Max. flexibility

# Interconnection.



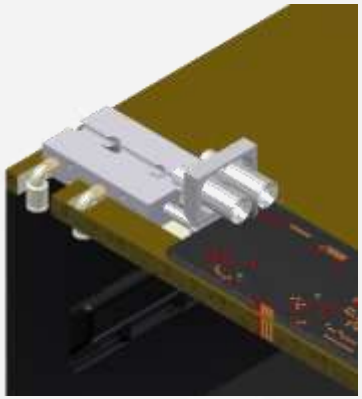


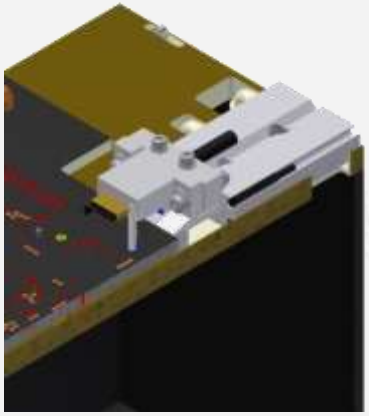
# 6TL-33

## Assembly

# ICT Fixturing

# FCT Fixturing

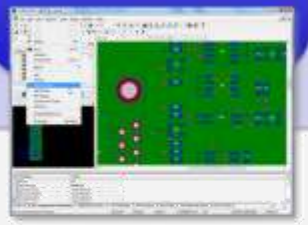




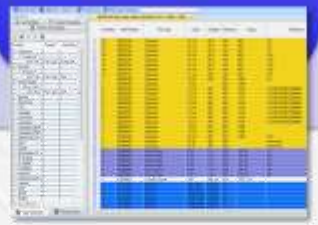
# software implementation ICT

## Easy Programming & Short Learning Curve


**C-Link**
CAD Import



**C-Link**
BOM Import



**C-Link**
Fixture Files

**CITE**
Gen Fast APG

**QMAN**
Repair, SPC, Data Reporting

C-LINK DTM
CAD/CAM SOFTWARE

CITE
COMPUTER INTEGRATED TEST ENVIRONMENT

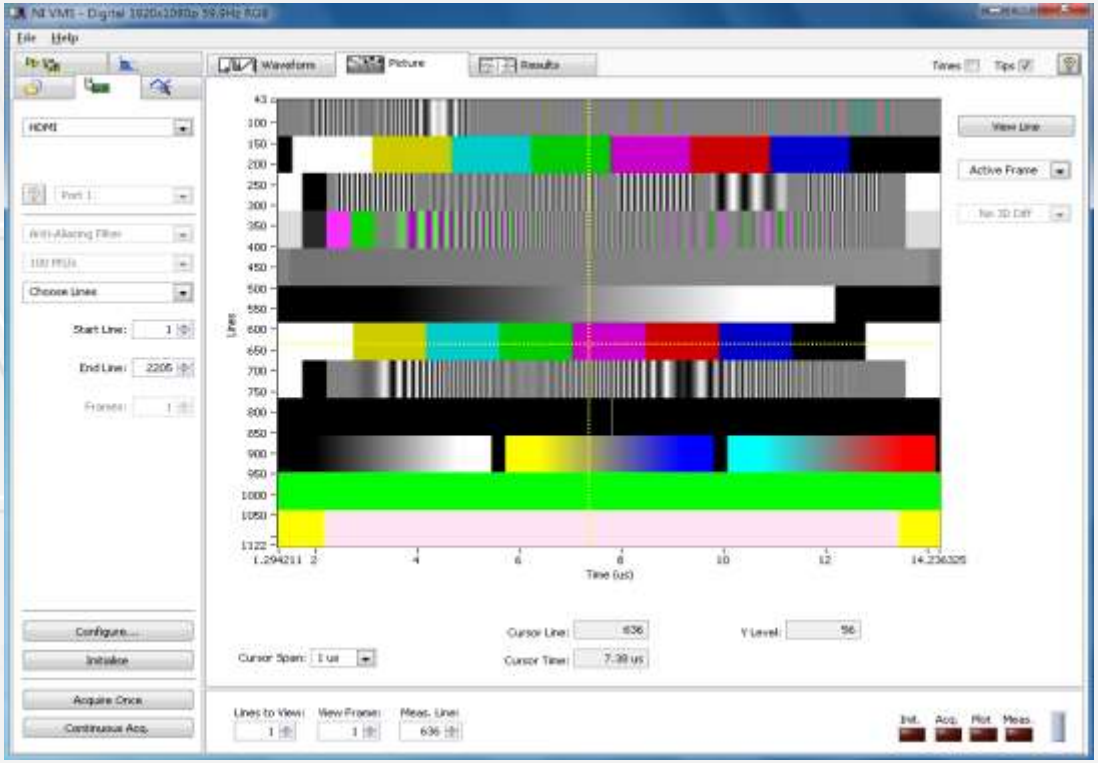
QMAN
PAPERLESS REPAIR

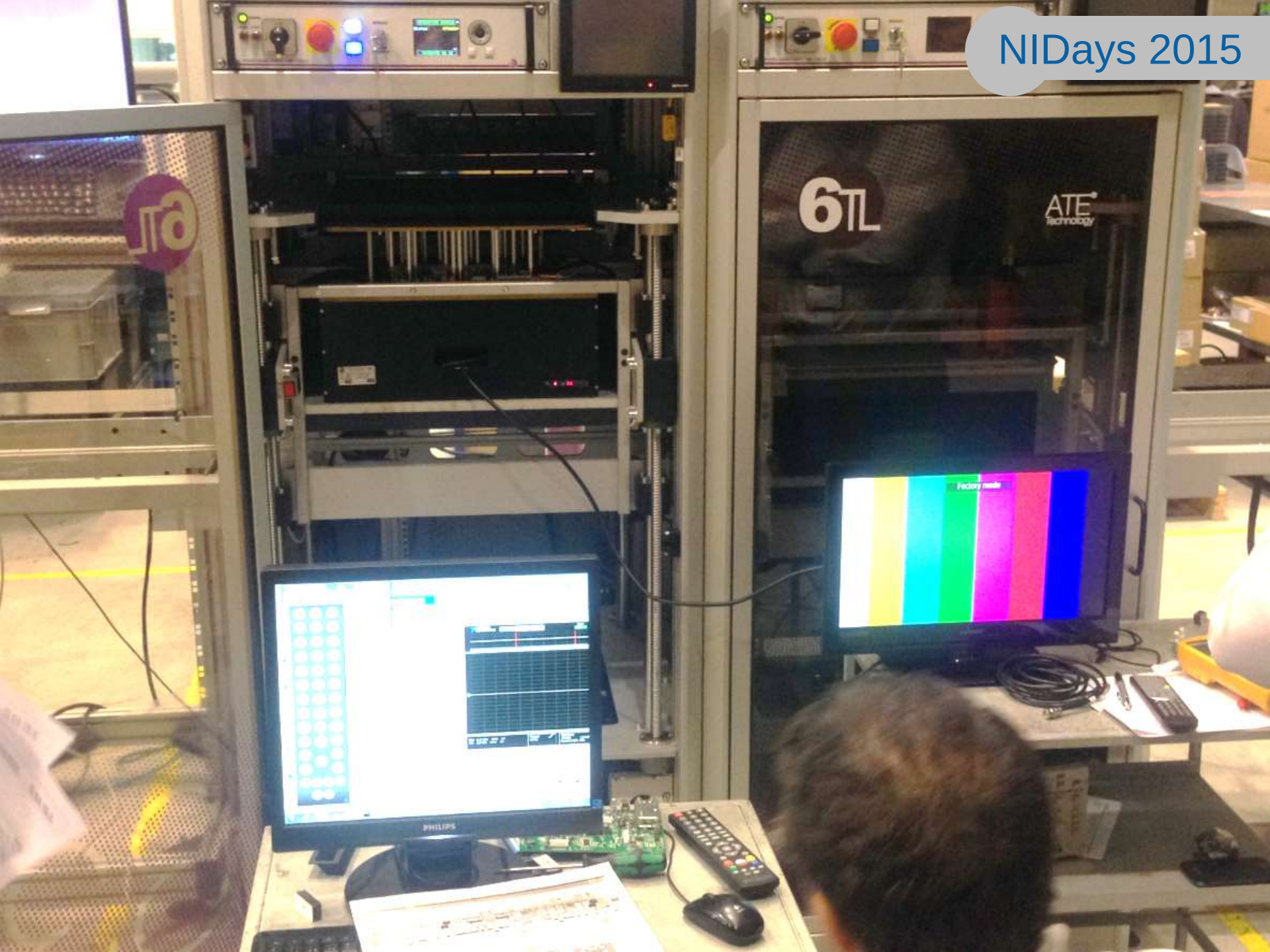
# software implementation FCT

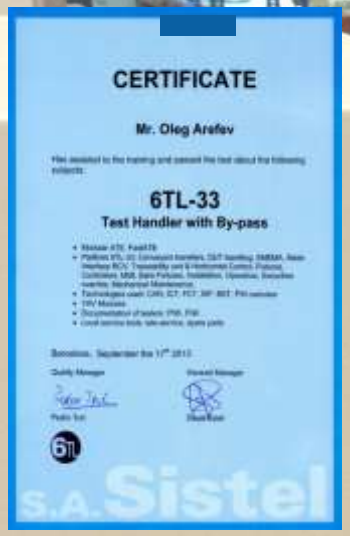
Test sequence implementation with: NATIONAL INSTRUMENTS™ TestStand™

- Voltage & Currents
- Infrared port
- SCART
- HDMI
- USB
- SPDIF

NI's Video Measurement Suite




NIDays 2015
6TL
ATE
Factory mode
PHILIPS



CERTIFICATE

Mr. Oleg Arefev

6TL-33

Test Handler with By-pass

CERTIFICATE

Mr. Konstantin Melekhin

6TL-33

Test Handler with By-pass


6TL
ATE
6TL
ATE
6TL


NIDays 2015
6TL
ATE
CE
BL-460A-CT

# Short movie after installation.

NIDays 2015

# Ready for High Volume Production

# Questions ?



Reliable Off-line Automated Test System for ICT & FCT

Test System using *fast*ATE, PXI, LabVIEW and Teststand.

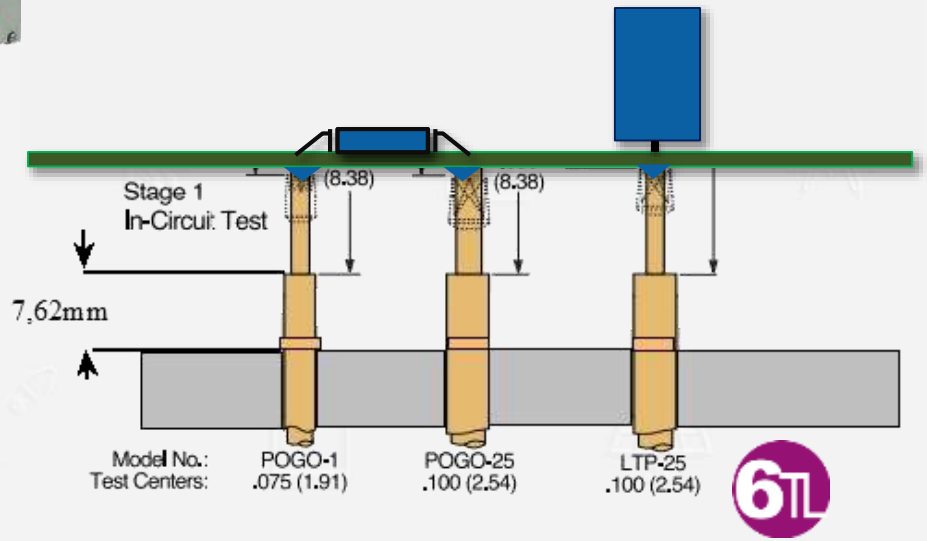
# Combinational Test (ICT + FCT). In one Test System, 6TL-24.



# Combinational Test (ICT + FCT). Build-in dual stage functionality



Loaded Board Testing Dual-Stage Application



# Combinational Test (ICT + FCT). From Off-Line to In-Line



fastATE technology

# Combinational Test (ICT + FCT).

- Available options in this test system
  1. Do the ICT test only
  2. Do the FCT test only
  3. Do a combinational test ICT and FCT
  4. Do an optimized combinational test, clever ICT and FCT
- Standard combinational test sequence ICT+FCT.
  1. Do the ICT test (20 sec) and when it passes do the FCT test (40 sec), when both pass (60 Seconds) the UUT is tested PASS.
  2. Repeat this until the ICT test passes X times (5 times by default) when the ICT test has passed X times in a row we skip the ICT test and do only the FCT test. (production process under control)
  3. Do only FCT test until fail then do ICT test on same board to find the fault and reset the value X.
  4. Goto step 2
- With the optimized combinational test you save 20 seconds or 33% testing time
- This enlarges the efficiency and output of your production line.
- The better you have control over your production process the higher your output.