Knotenimpedanzanalyse – eine alternative Prüfmethode für den Kleinserientest und Reparatureinatz

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Funktionstest

- Prüft bauteilinterne Funktionen, korrekte Programmierung etc.
- Findet auch dynamische und thermische Fehler

- Erfordert Grundfunktionsfähigkeit
- Findet häufig keine fehlenden C´s
- Test unter Versorgung → Gefahr von Folgefehlern
- Häufig komplexere Testaufbauten nötig
- Sucht Fehlerauswirkung, nicht Fehlerursache

In-Circuit-Test

- Prüft Bauteile auf korrekte Werte, Polung, bauteilinterne Funktionen, korrekte Programmierung etc.
- Hoher Durchsatz
- Komplexe Programmierung
- Erfordert digitale Prüfmuster für IC´s
- Aufwändige Kontaktierung (Nadelbett oder Flying Probe
- Für Reparatureinsatz zu unflexibel

Boundary-Scan-Test

- Einfache Kontaktierung
- Prüft komplexe IC´s

- Komplexe Programmierung
- Häufig keine ausreichende Fehlerabdeckung für diskrete Bauteile

Visual Inspection

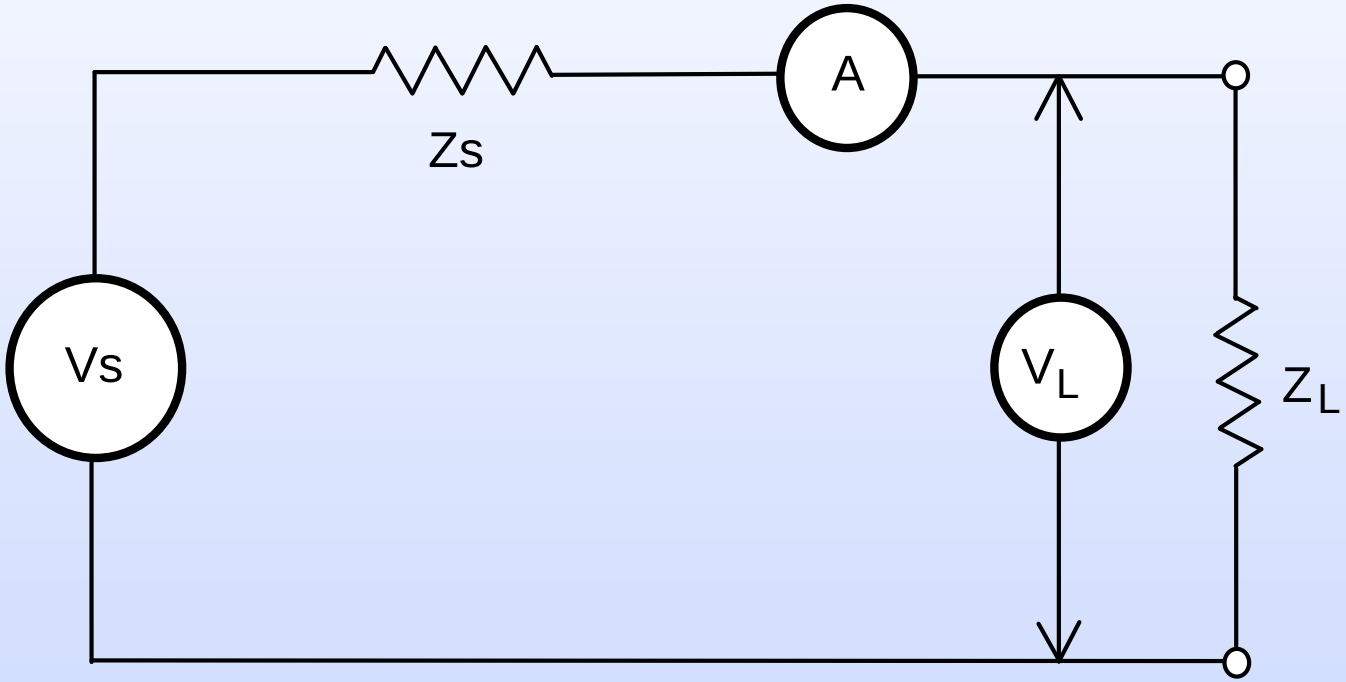
- Hoher Durchsatz
- Texterkennung, IC-Typen etc.

- Komplexe Programmierung
- Eingeschränkte Erkennung falscher Bauteilwerte
- Findet keine Kurzschlüsse unterhalb Bauteile bzw. in der Leiterplatte

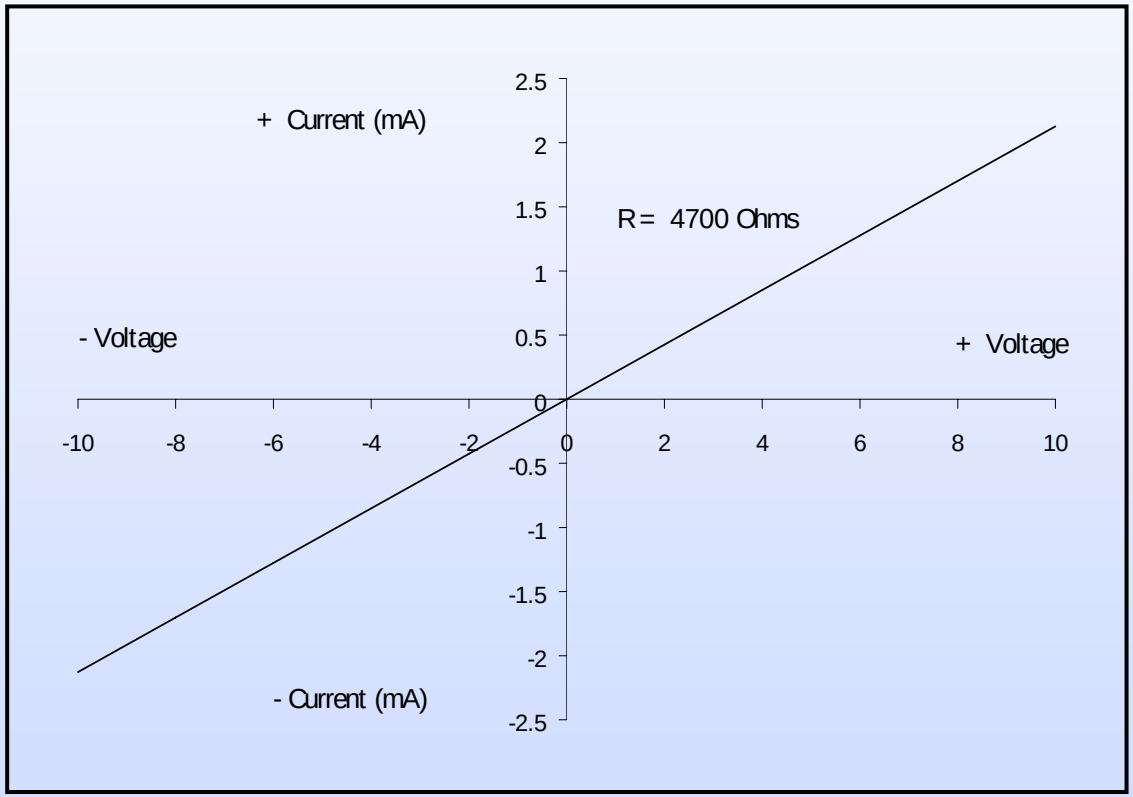
Knotenimpedanzanalyse

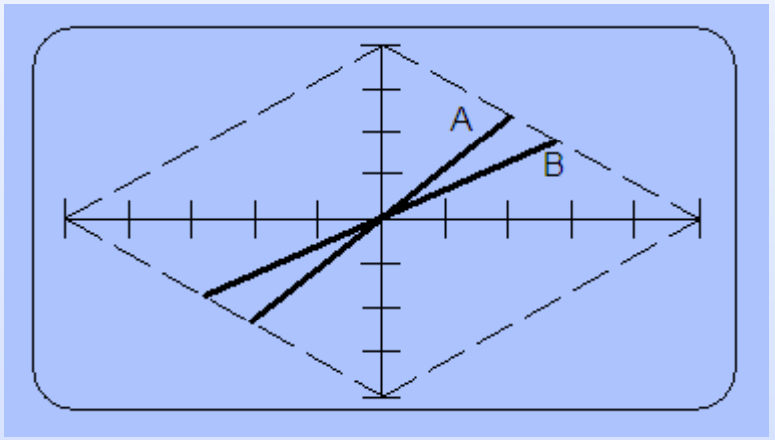
- Findet typische Fertigungsfehler, defekte Bauteile
- Keine Bauteilbibliothek erforderlich
- Technologieunabhängig
- Test im stromlosen Zustand
- Einfache Programmierung (Gutmuster)
- Eingeschränkte Erkennung bauteilinterner Fehler
- Mißt keine Bauteilwerte/Toleranzen
- Keine dynamische/thermische Fehler
- Interpretationsfähigkeit durch Bediener nötig

Das Funktionsprinzip



Strom/Spannungsdarstellung



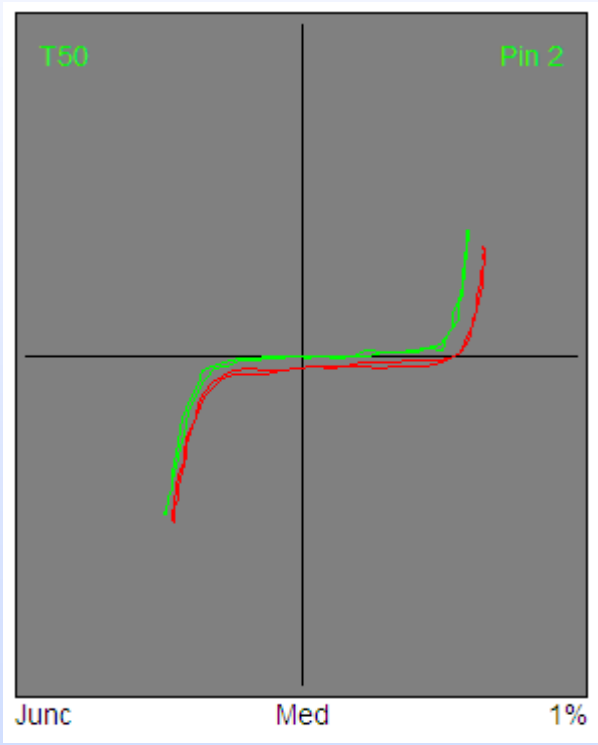


Signaturvergleich

- Kalibrierung des Meßaufbaus
- 100 Meßpunkte entlang einer Sinusperiode
- Messung am Prüfling
- Vergleich der Signaturen

$$D = 1/n \sum_{1}^{n} | Va_n - Vb_n | \times k\%$$

- Gewichtung

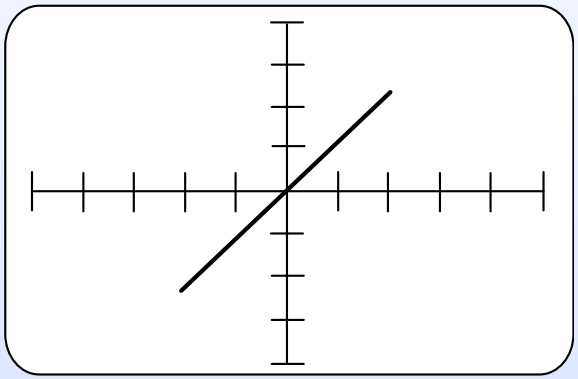


Die Testspannungen/Frequenzen

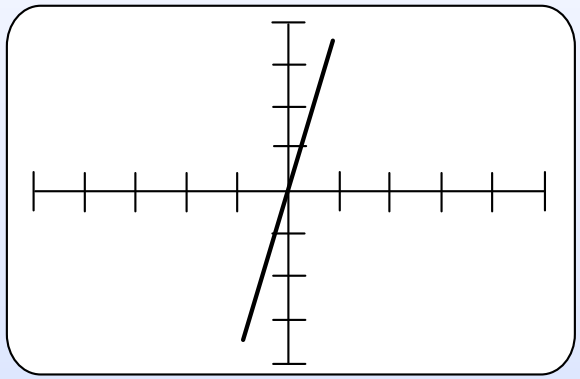
Bereich	Spitzenspannung	Spitzenstrom
Junction	1V	500µA
Logic	10V	5mA
Low	10V	150mA
Med	20V	1mA
High	40V	1mA

90 Hz, 500 Hz, 2 kHz

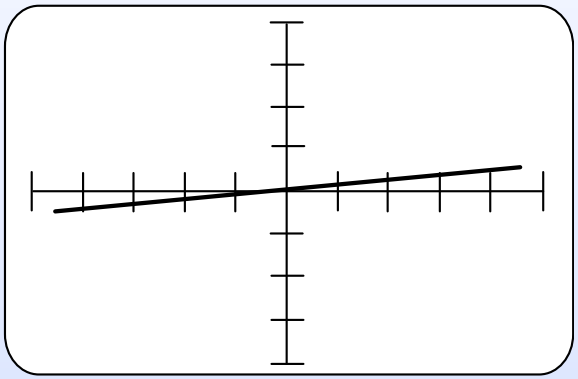
Widerstandsmessung



2K Widerstand
Logic Bereich
Low Frequenz

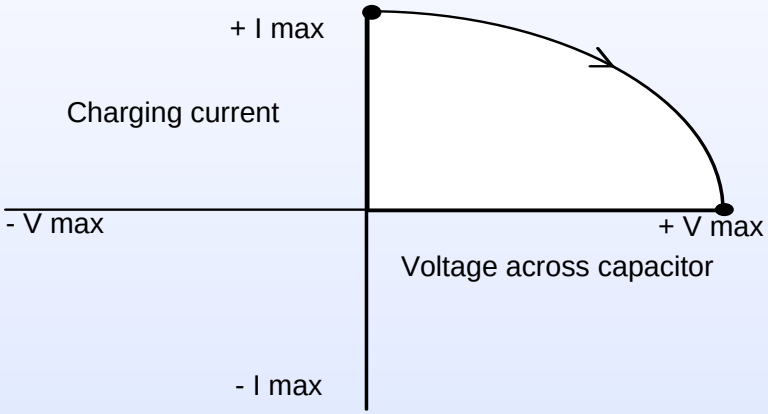


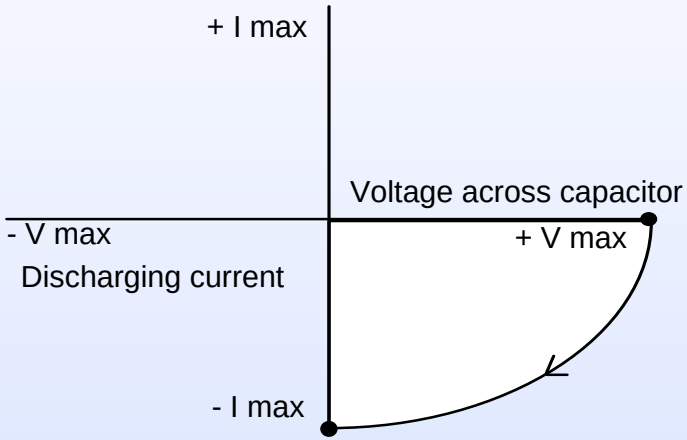
10K Widerstand
High Bereich
Low Frequenz

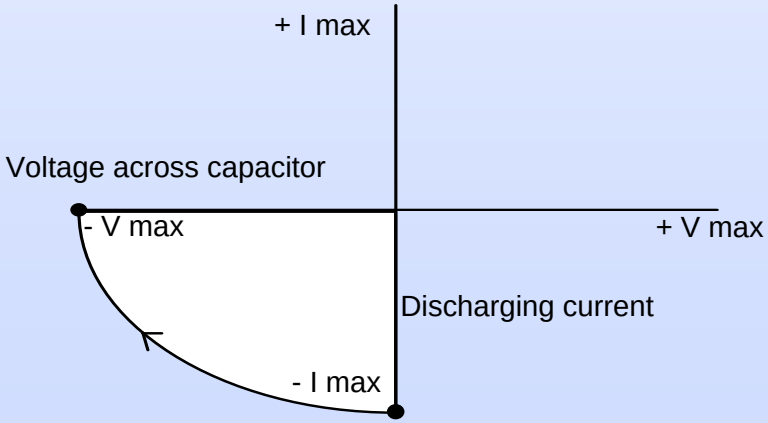


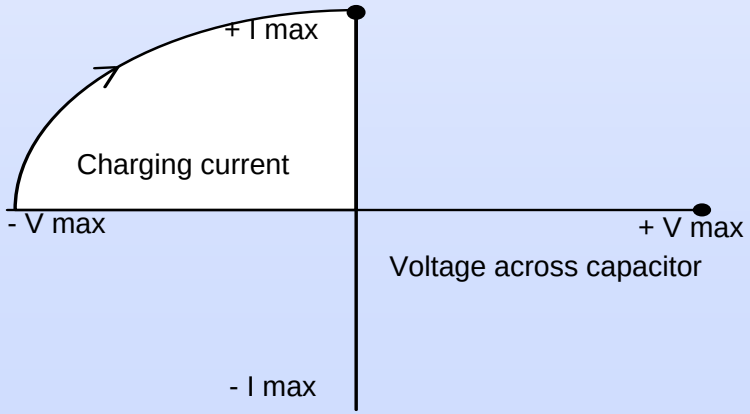
270K Widerstand
High Bereich
Low Frequenz

Test von Kondensatoren

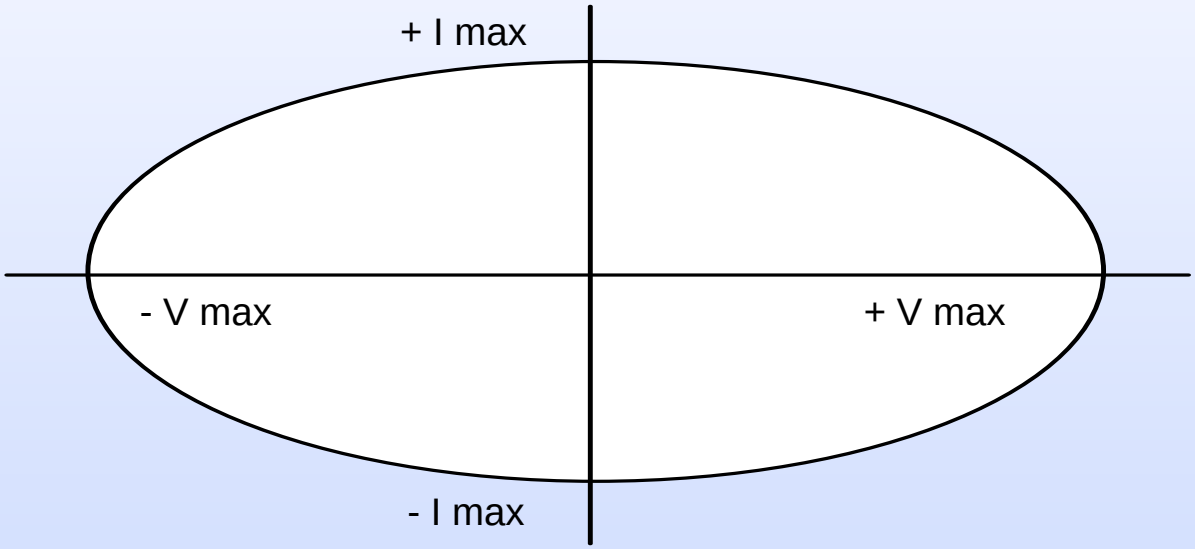


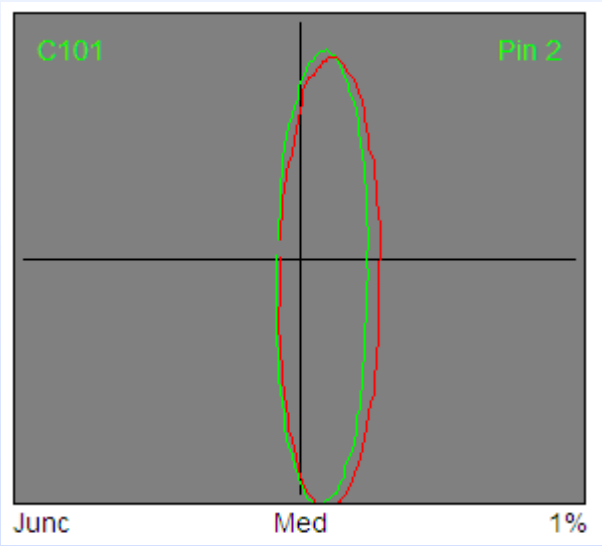






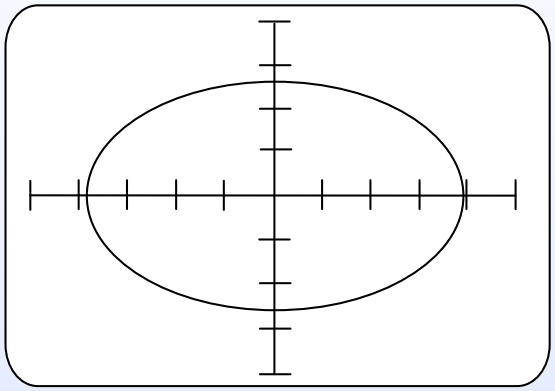
Test von Kondensatoren



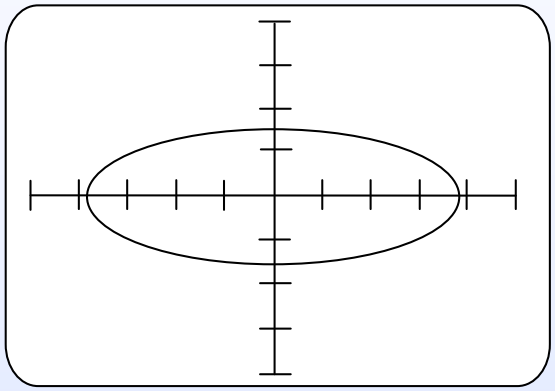


Kapazitive Reaktanz $$X_c = \frac{1}{2\pi f C}$$

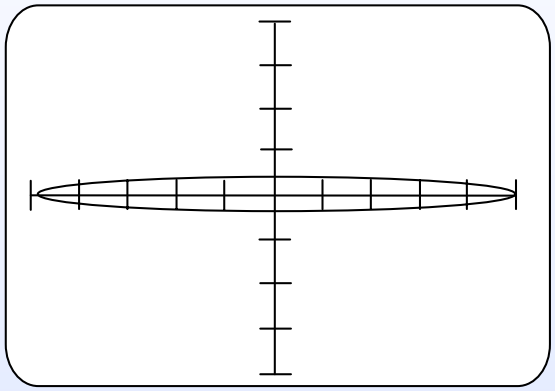
Kapazitätsmessung



22uF Kondensator
Low Bereich
Low Frequenz

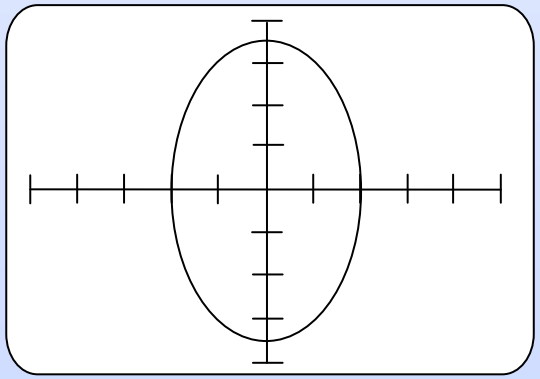


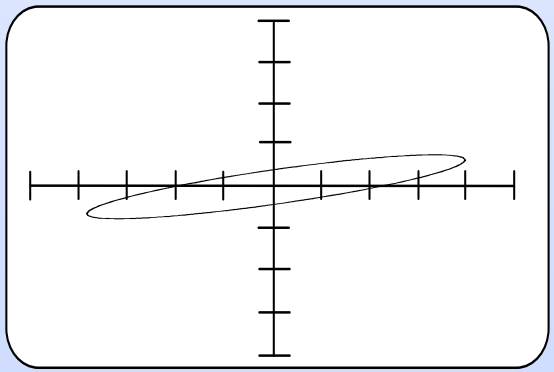
10uF Kondensator
Low Bereich
Low Frequenz



82pF Kondensator
High Bereich
High Frequenz

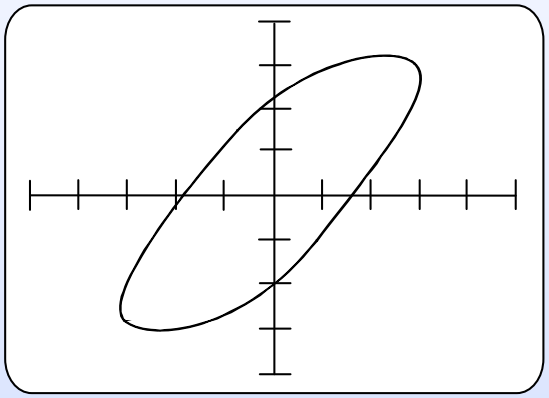
47uF Kondensator
Low Bereich
Low Frequenz
Gutes Bauteil



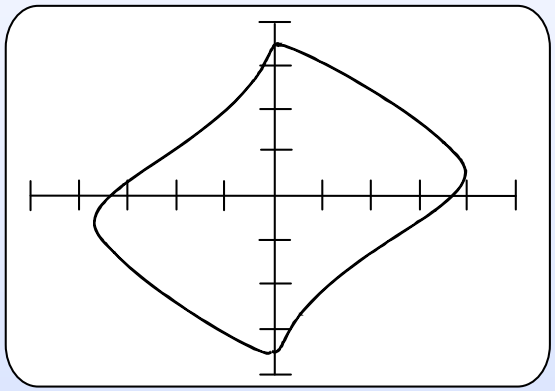


47uF Kondensator
Low Bereich
Low Frequenz
Defekter Kondensator mit ohmschen Anteil

Induktivitätsmessung

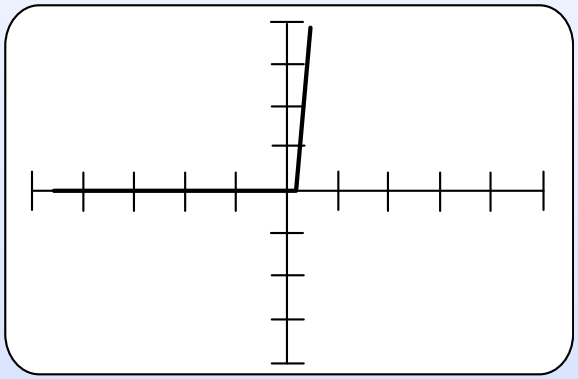


Ferrittransformator
Primärseite
Low Bereich
High Frequenz

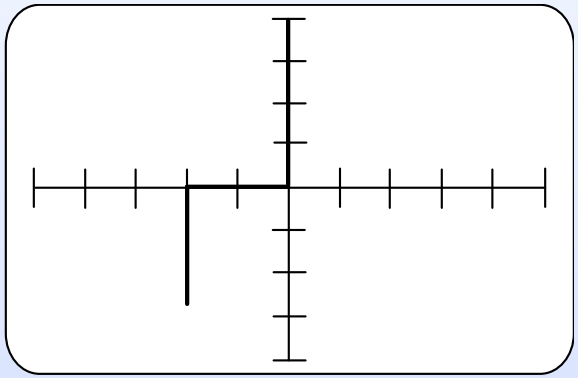


Ferrittransformator
Primärseite
Low Bereich
High Frequenz
Kurzgeschlossene
Windung

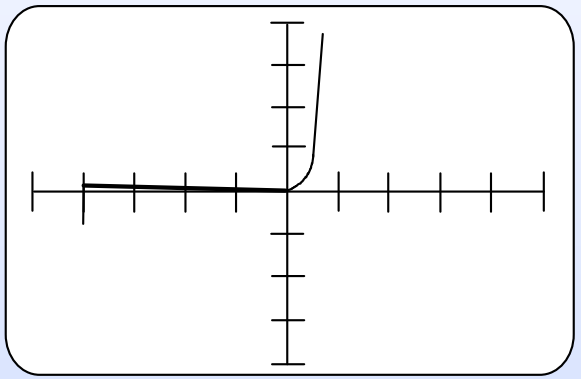
Test von Halbleitern



Kleinsignaldiode
Logic Bereich
Low Frequenz

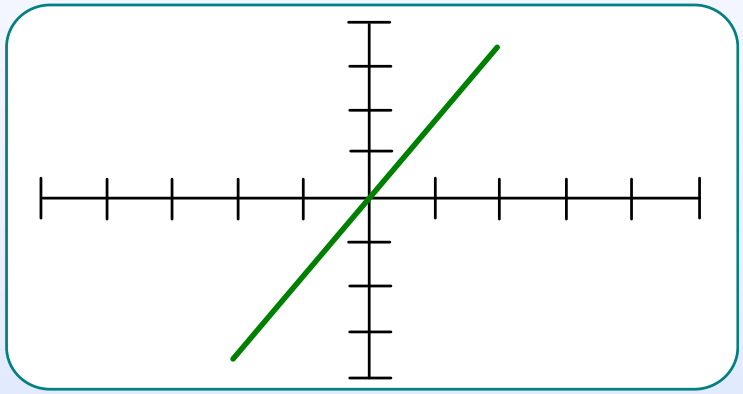


8.2V Zenerdiode
Med Bereich
Low Frequenz

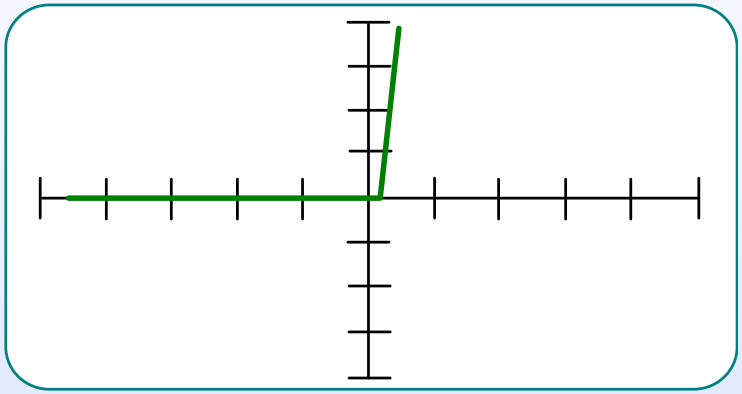


NPN Transistor
Basis-Emitter
Med Bereich
Low Frequenz

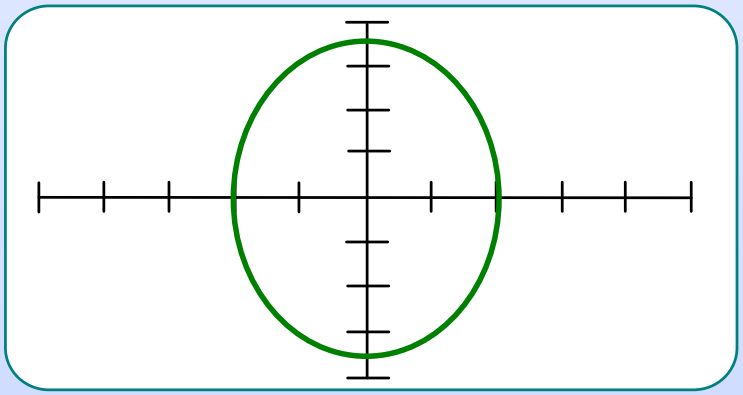
Parallelschaltung von Bauteilen



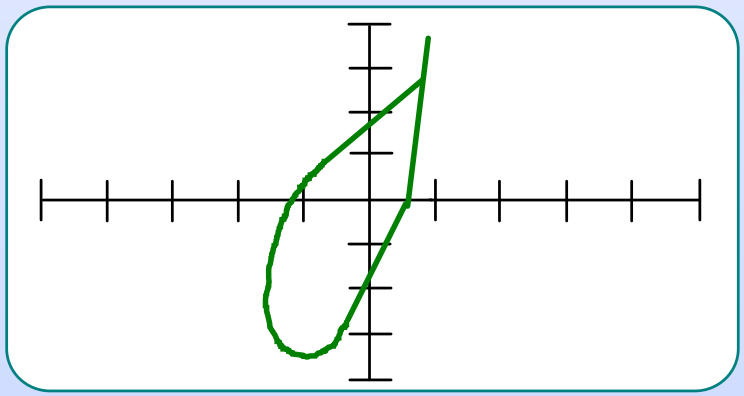
Widerstand



Diode

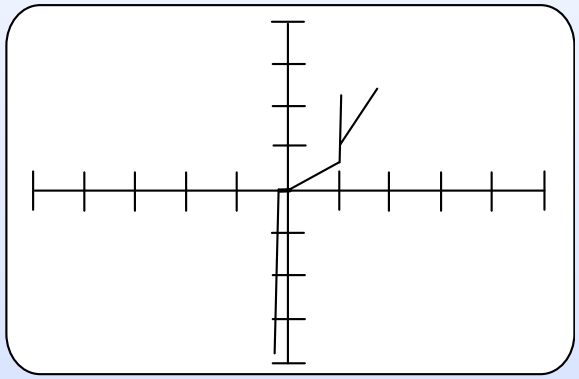


Kondensator

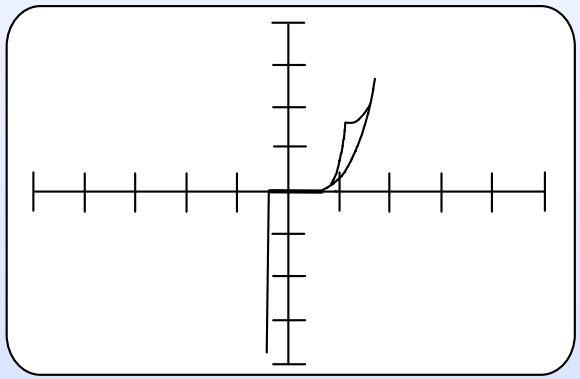


Parallelschaltung

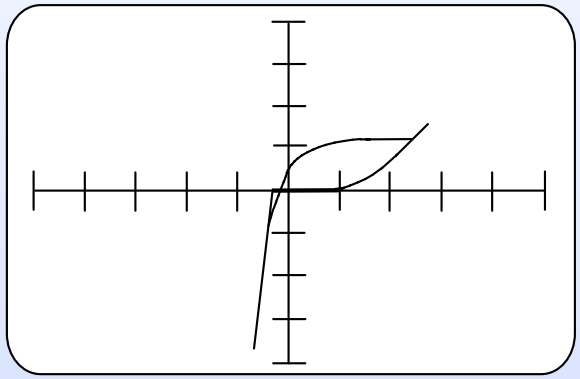
Test von IC´s



74LS00
Logic Bereich
Low Frequenz
Ausgang gegen Masse

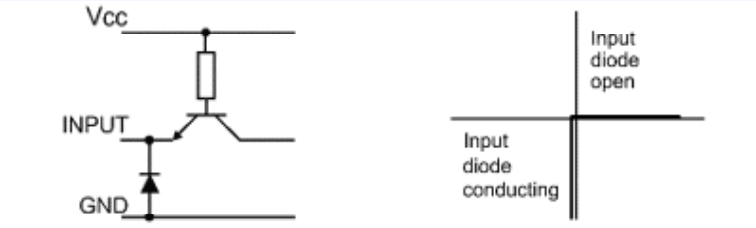


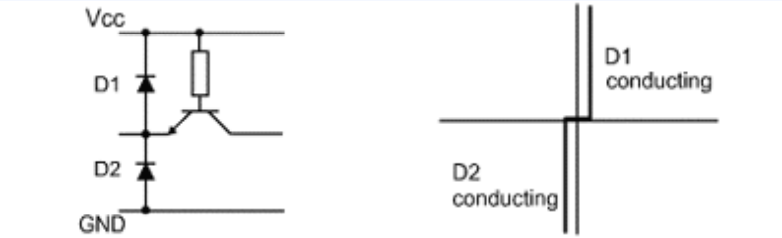
74HC02
Logic Bereich
Low Frequenz
Ausgang gegen Masse

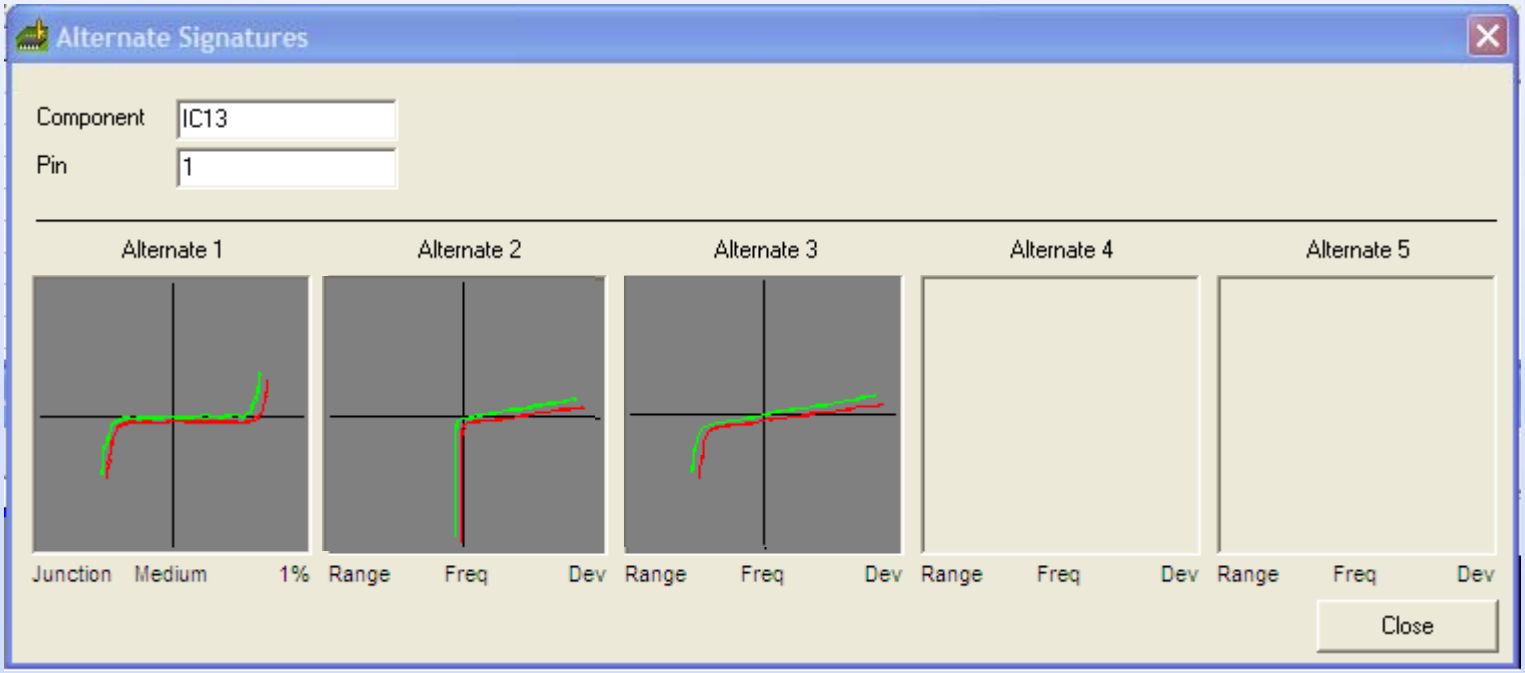


4017
Logic Bereich
Low Frequenz
Ausgang gegen Masse

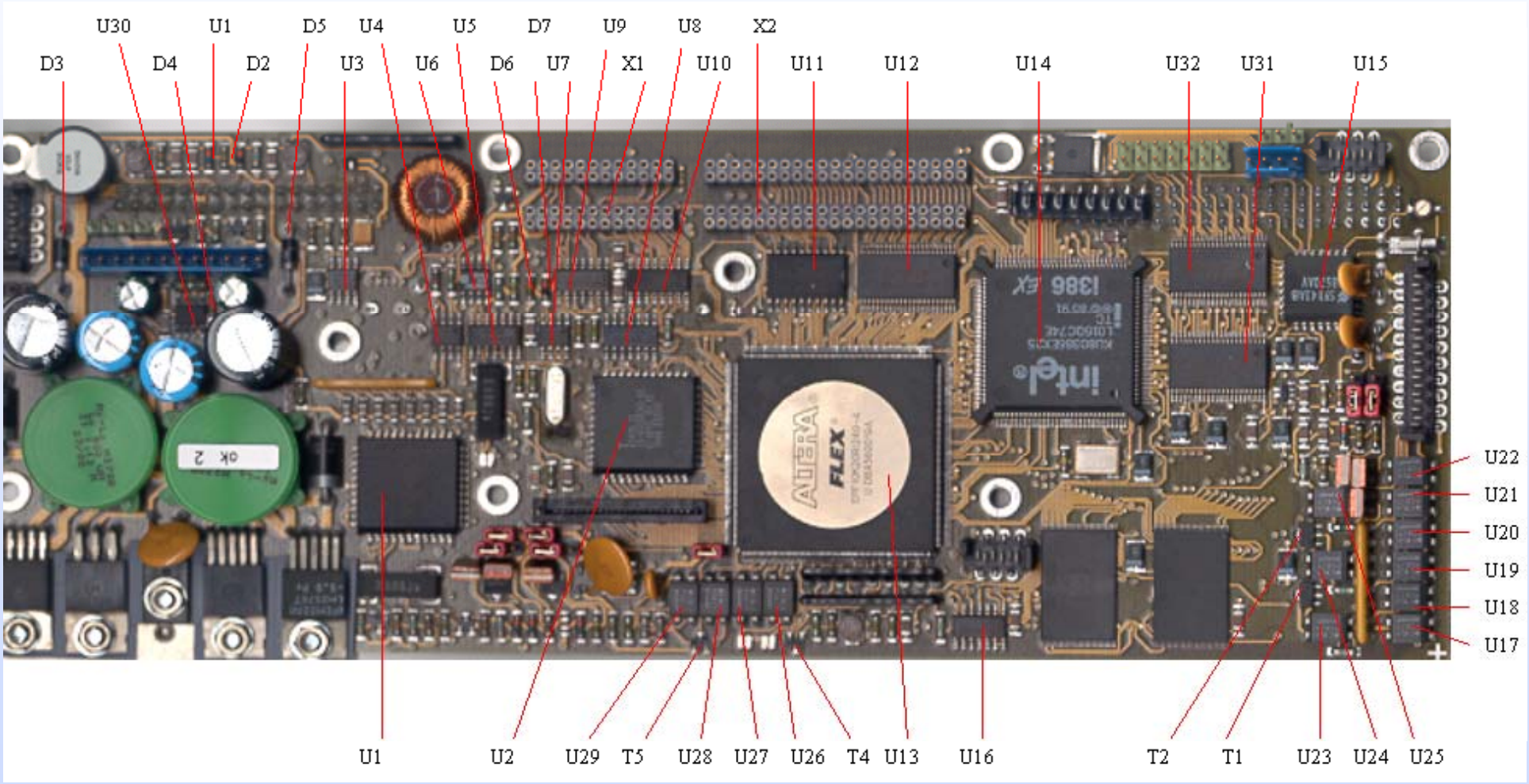
Pseudofehler durch Herstellerunterschiede



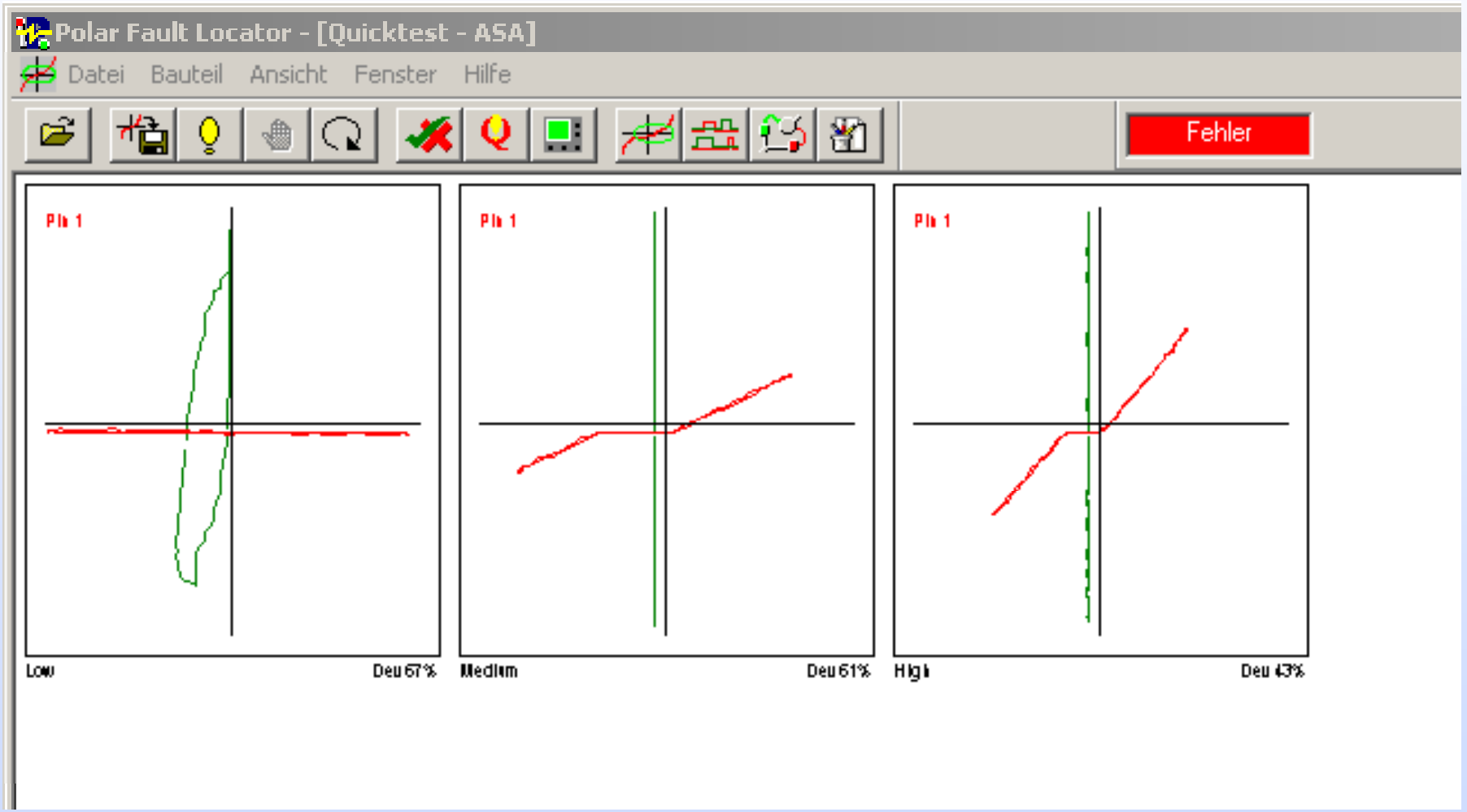




Typische Fehlerbilder

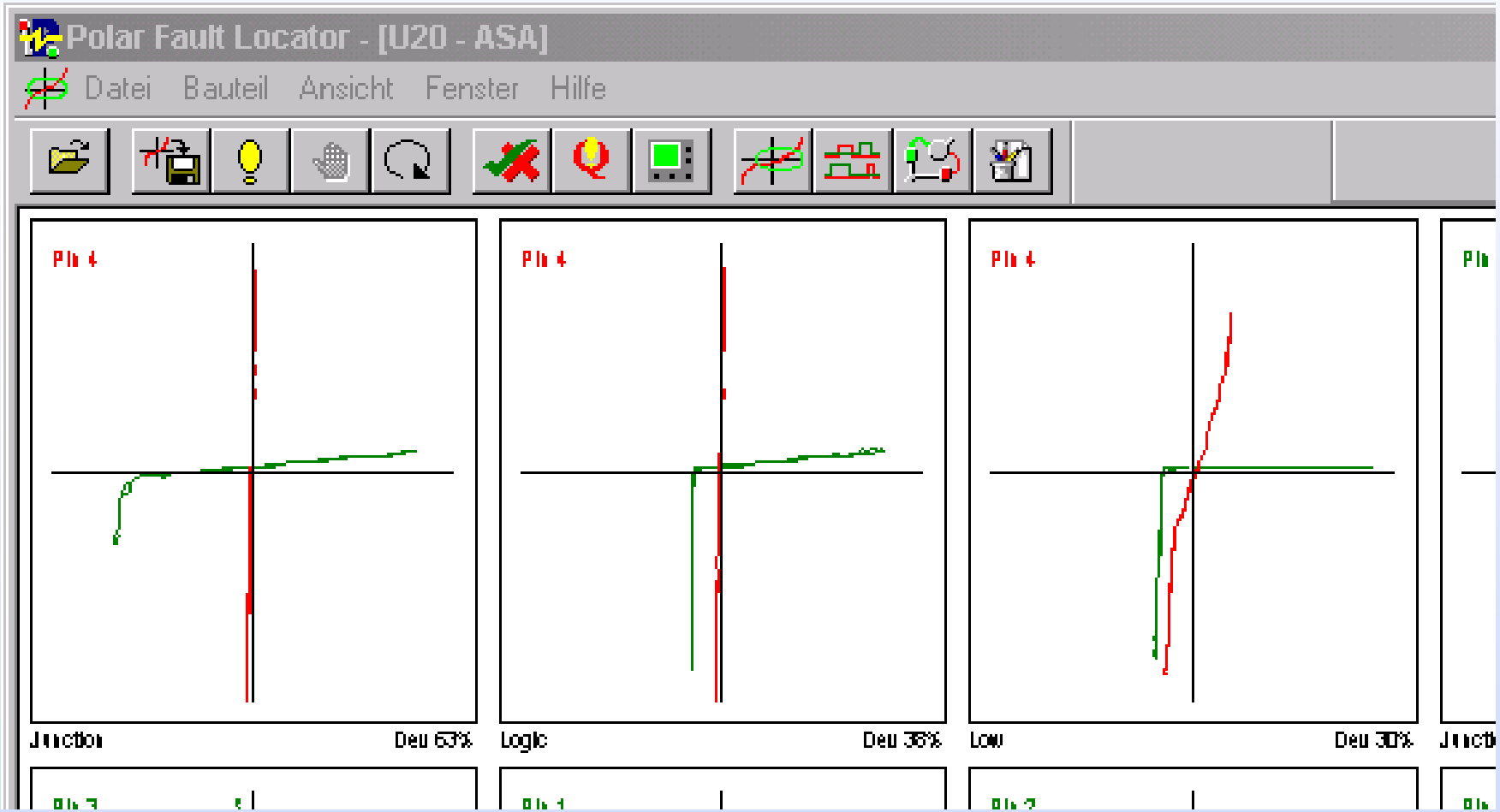


Typische Fehlerbilder



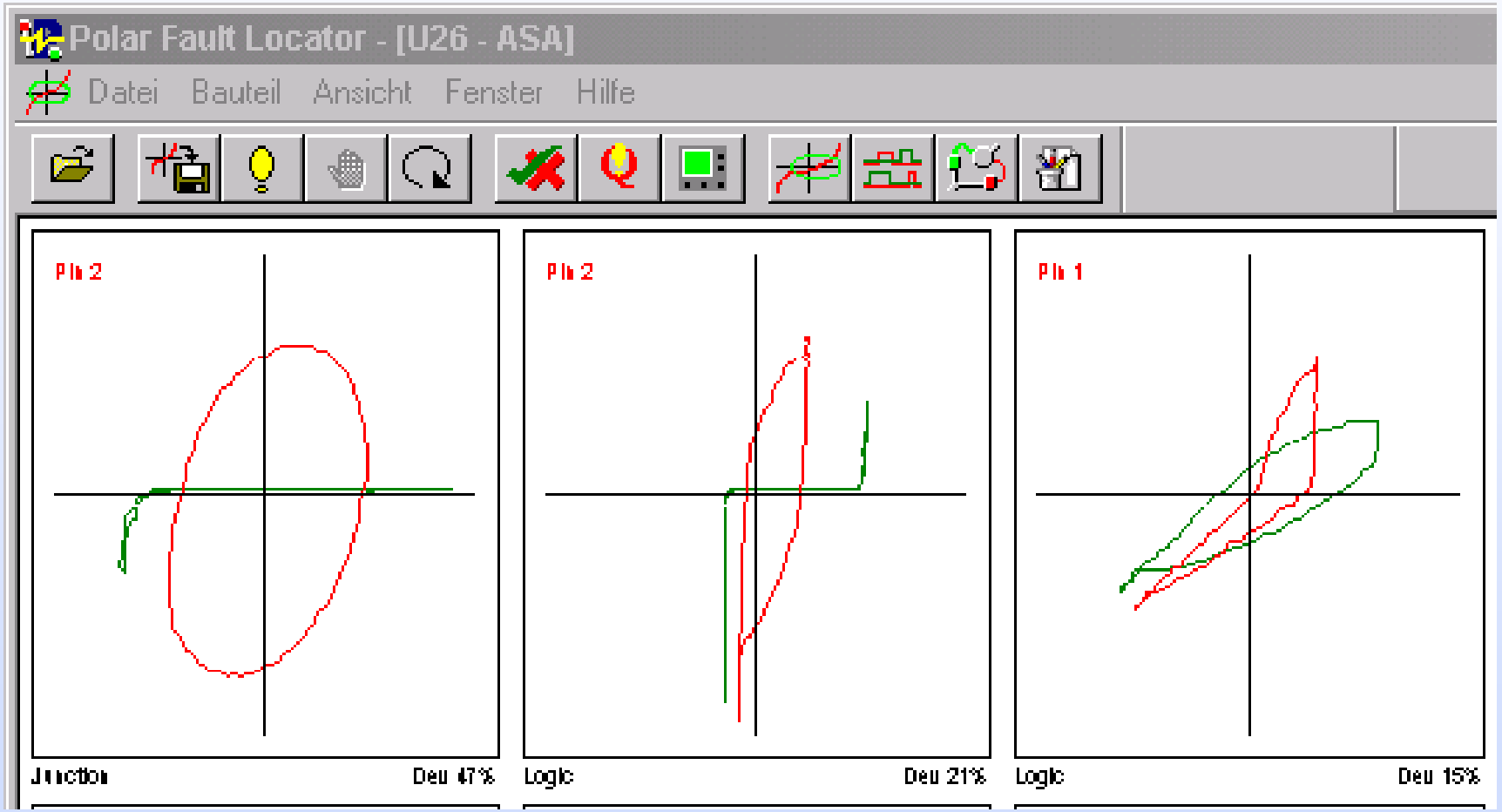
Widerstand nicht gelötet

Typische Fehlerbilder



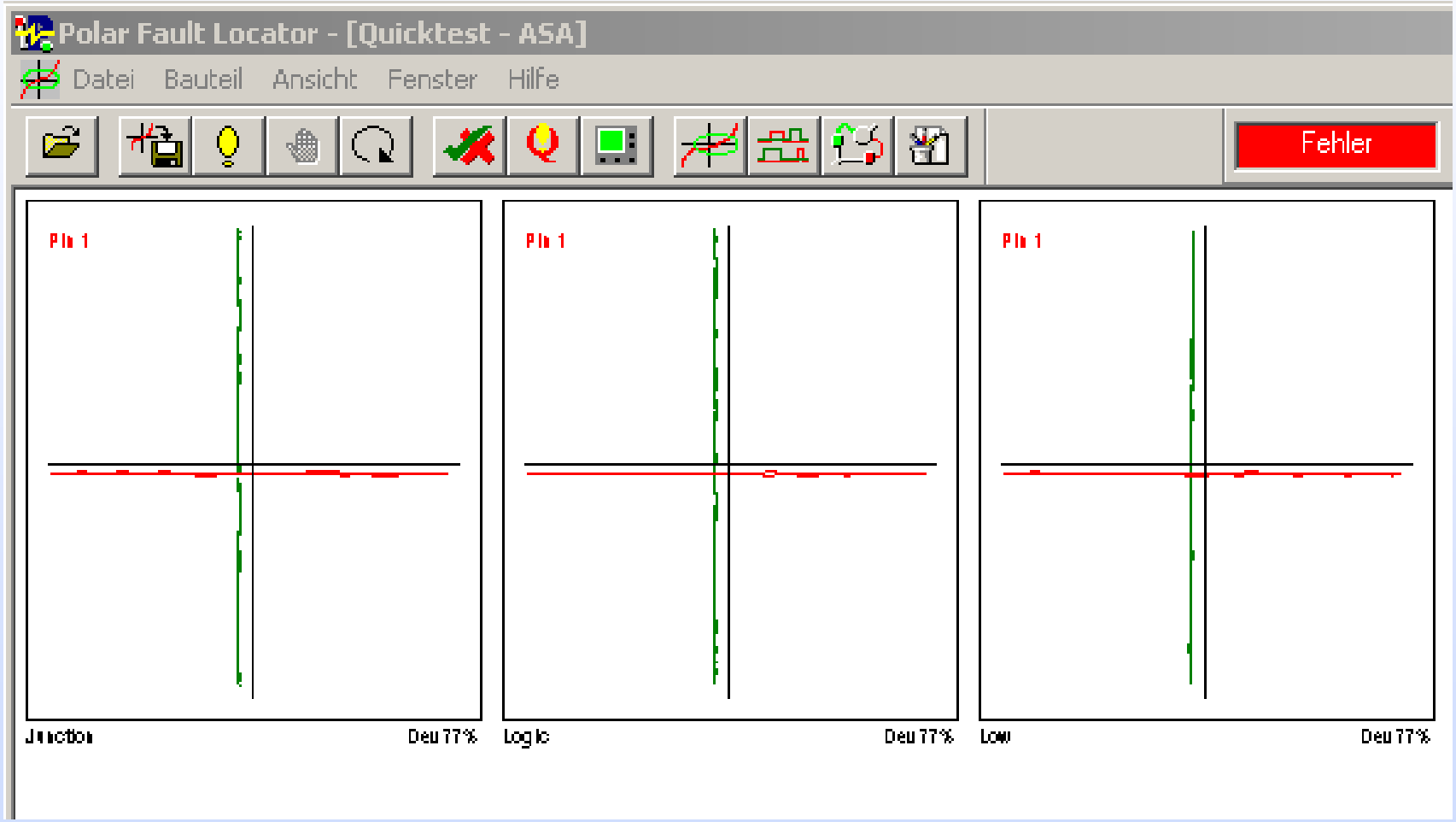
Masseschluss auf Pin 4

Typische Fehlerbilder



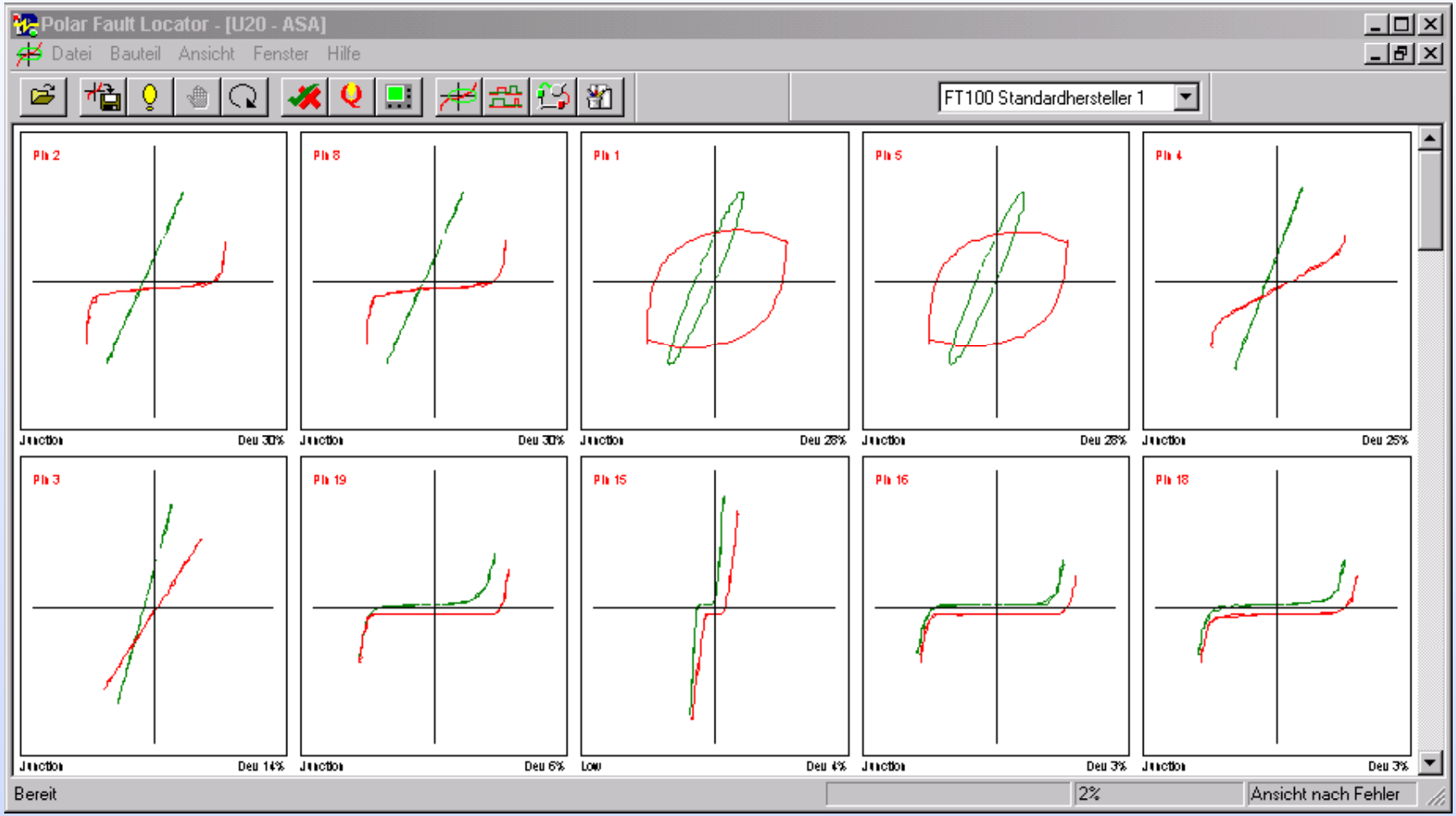
Defektes IC

Typische Fehlerbilder



Kondensator nicht gelötet

Typische Fehlerbilder

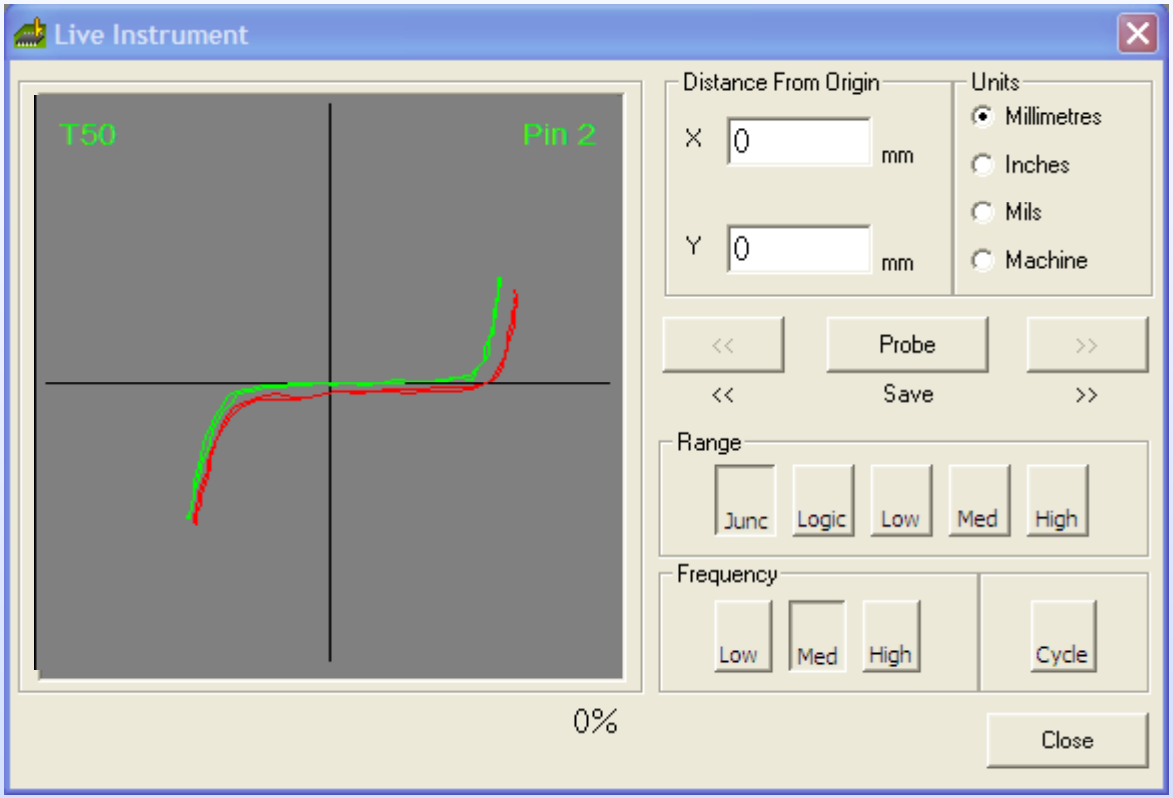


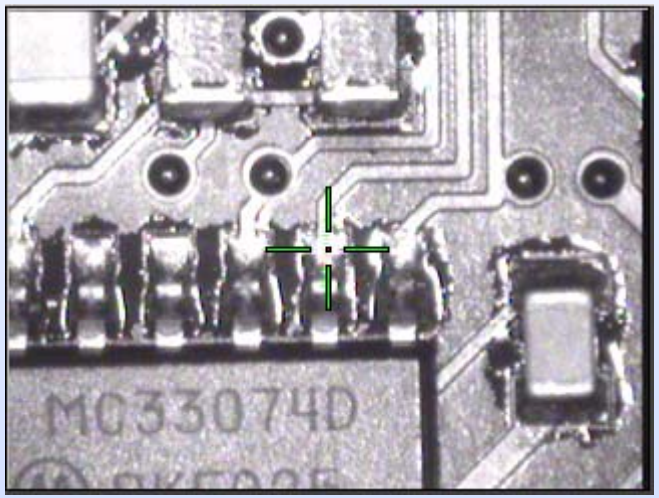
Mehrfache Fehler am IC

Prüfvoraussetzungen

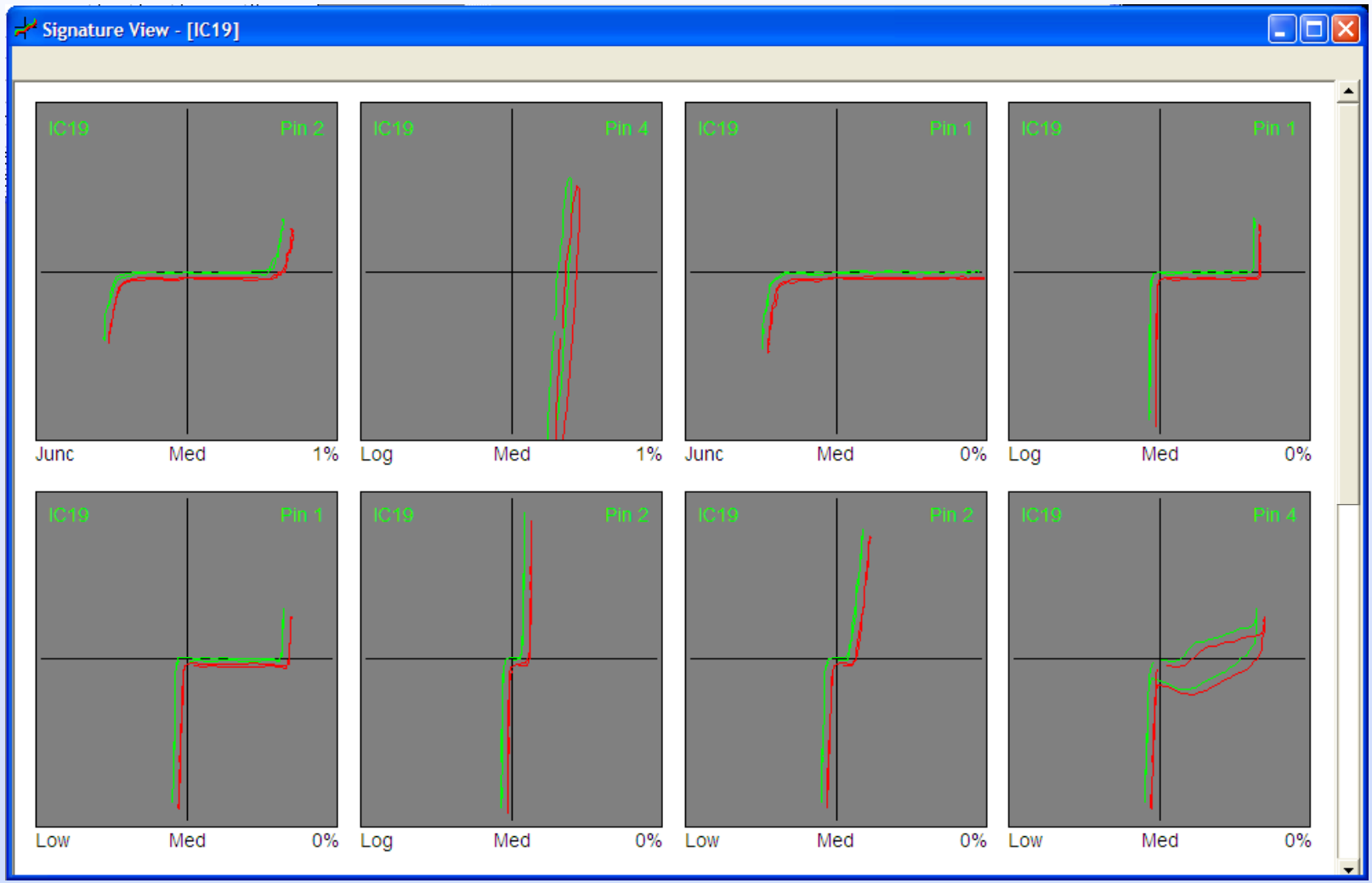
- **Leiterplatte muß stromlos sein**
- **Schaltungsnetz muß an einer Stelle zugänglich sein**
- **Sämtliche Versorgungsspannungen und Bezugsmassen kurzschließen**
- **Keine Guarding-Techniken erforderlich**
- **Keine dedizierten Testpads erforderlich**
- **Evtl. Vorhandene Pufferbatterien abklemmen**

Echtzeitdarstellung

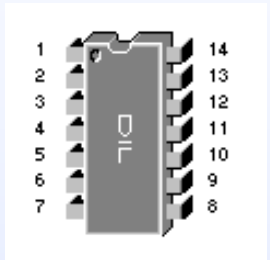


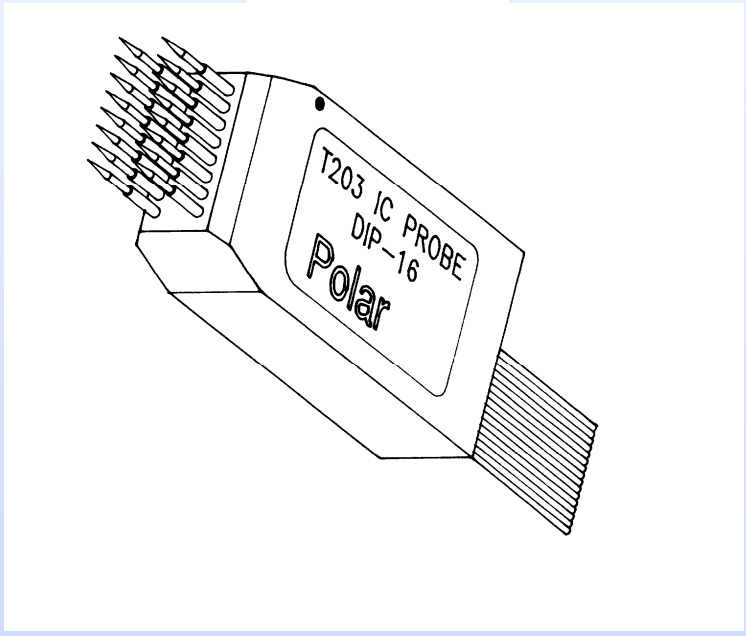


Der Speicherbetrieb

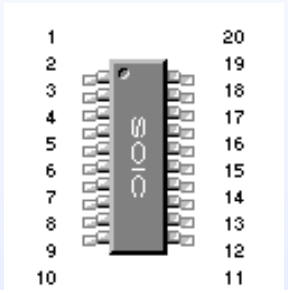


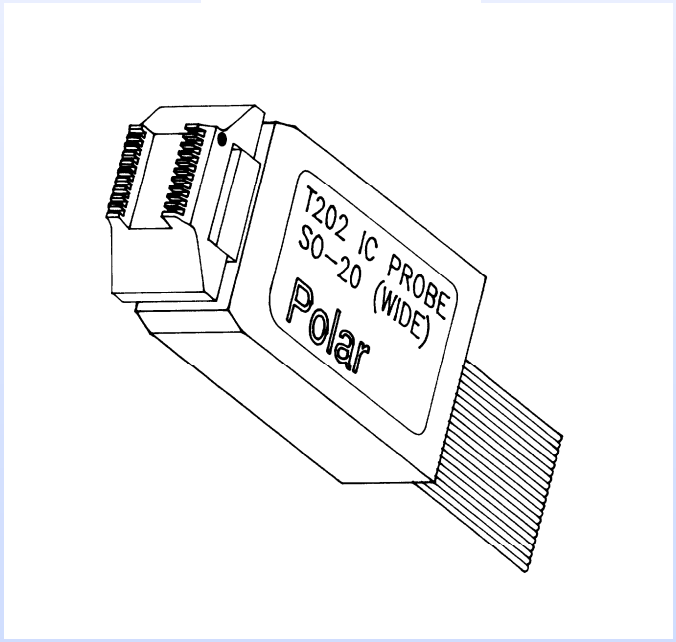
Kontaktiermethoden - Reparatur





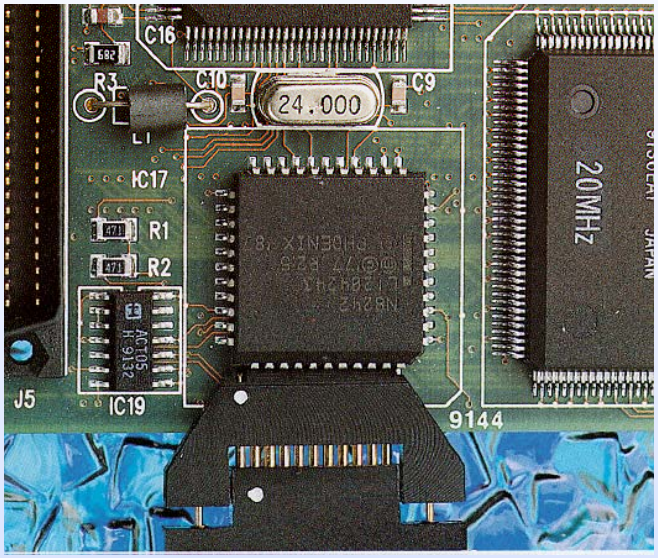
DIL- Prüfstempel

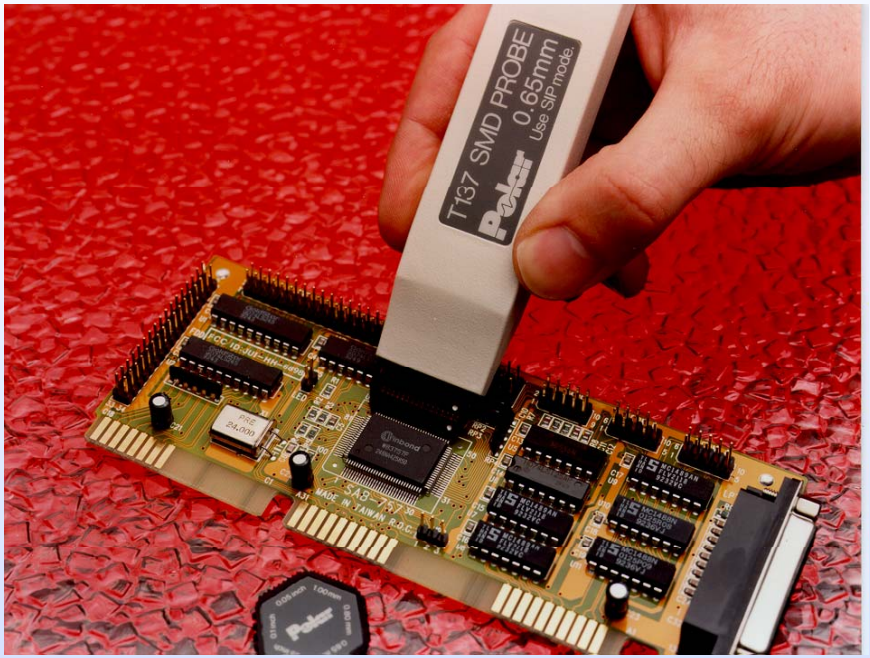


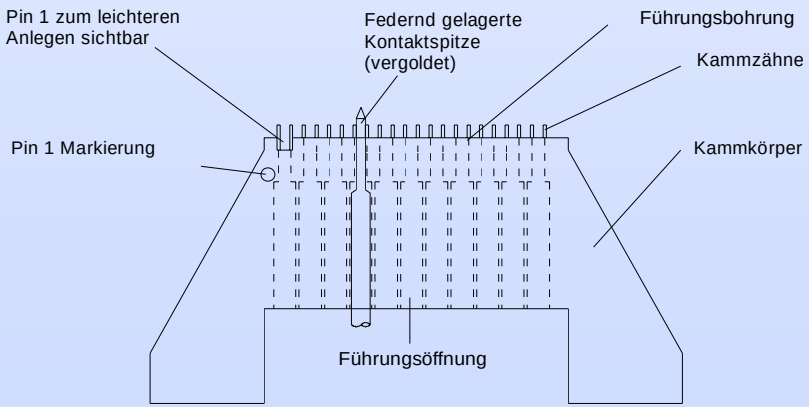


SOIC- Prüfstempel

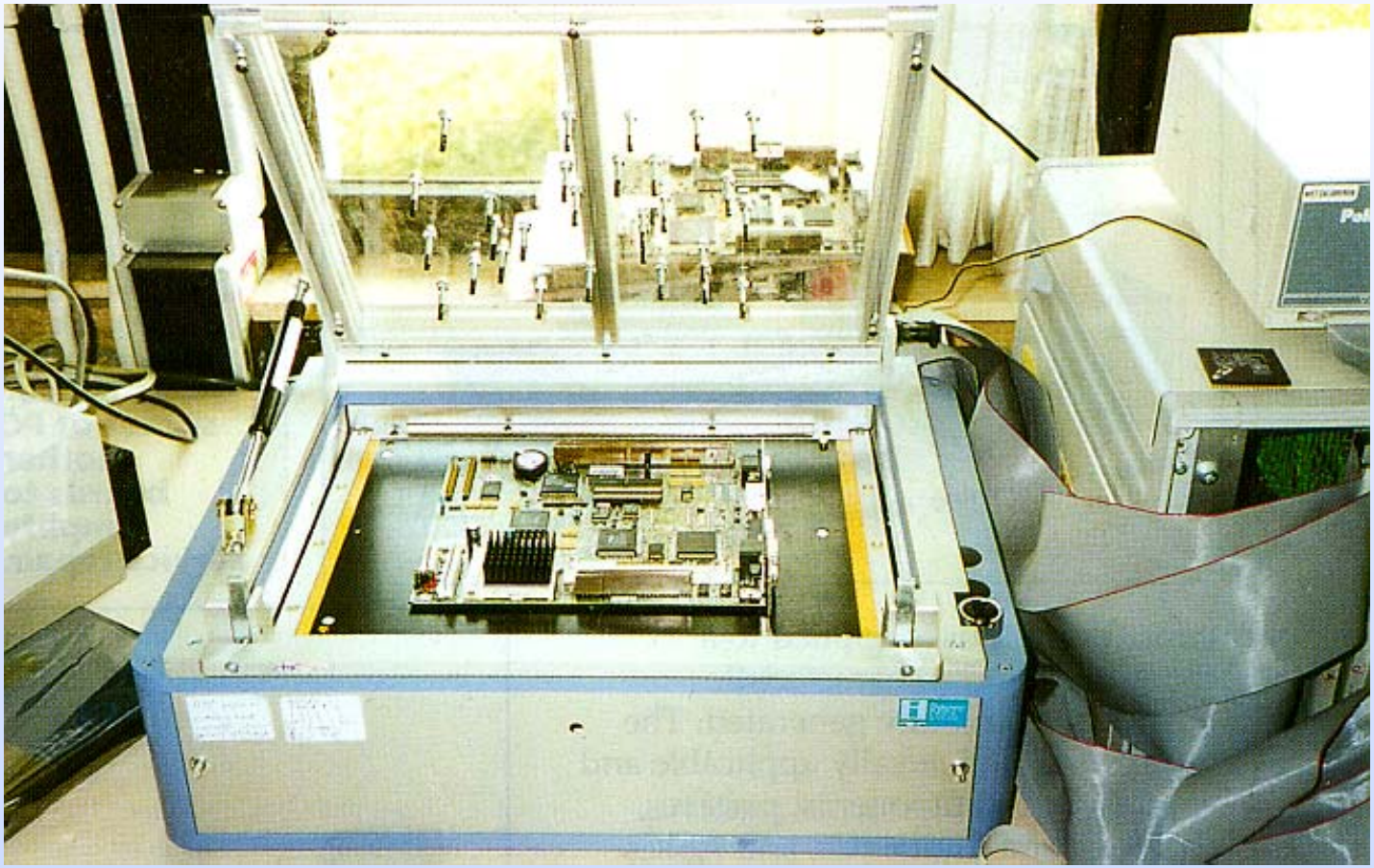
Kontaktiermethoden - Reparatur



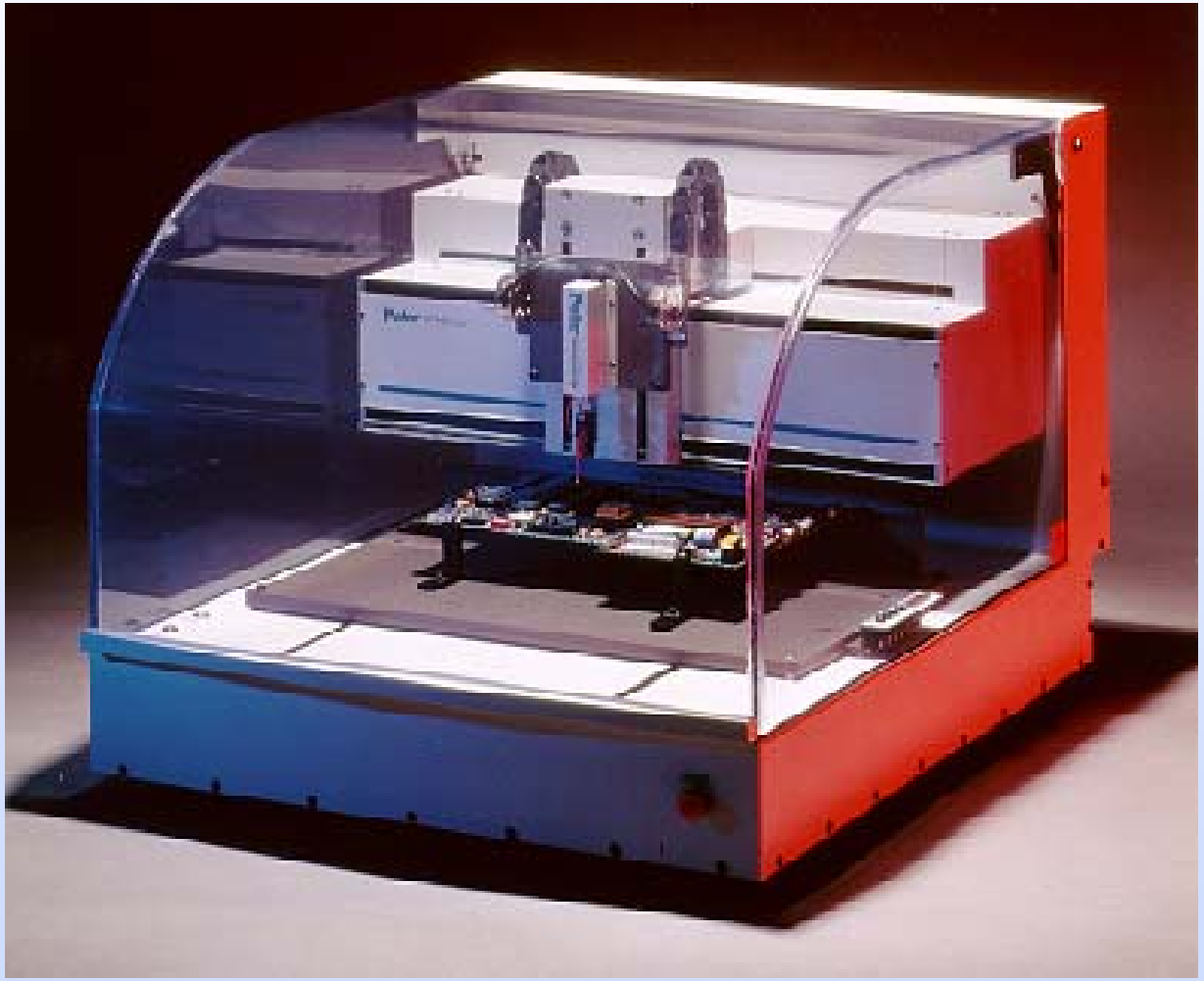




Nadelbettadapter

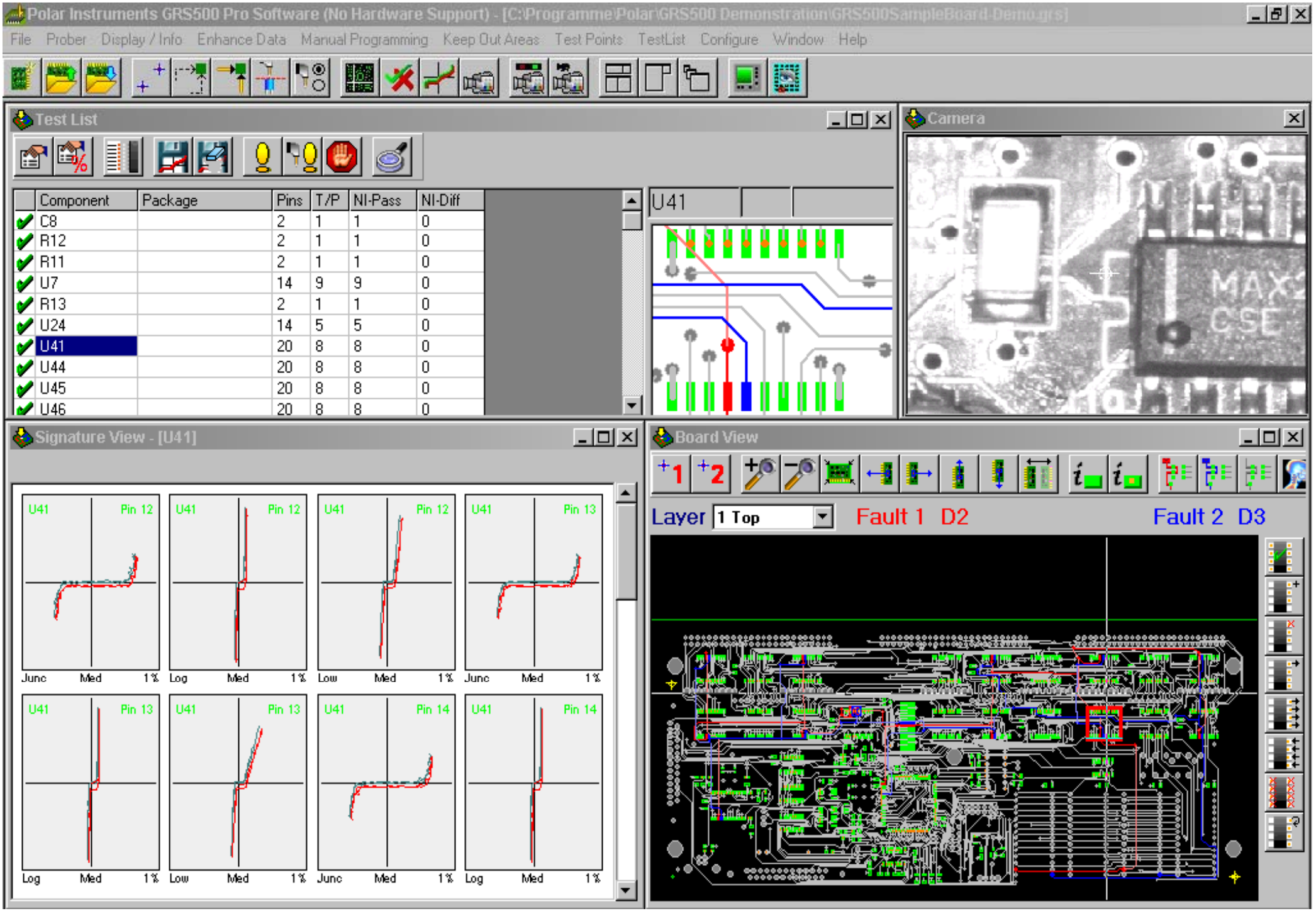


GRS500 Flying Probe System

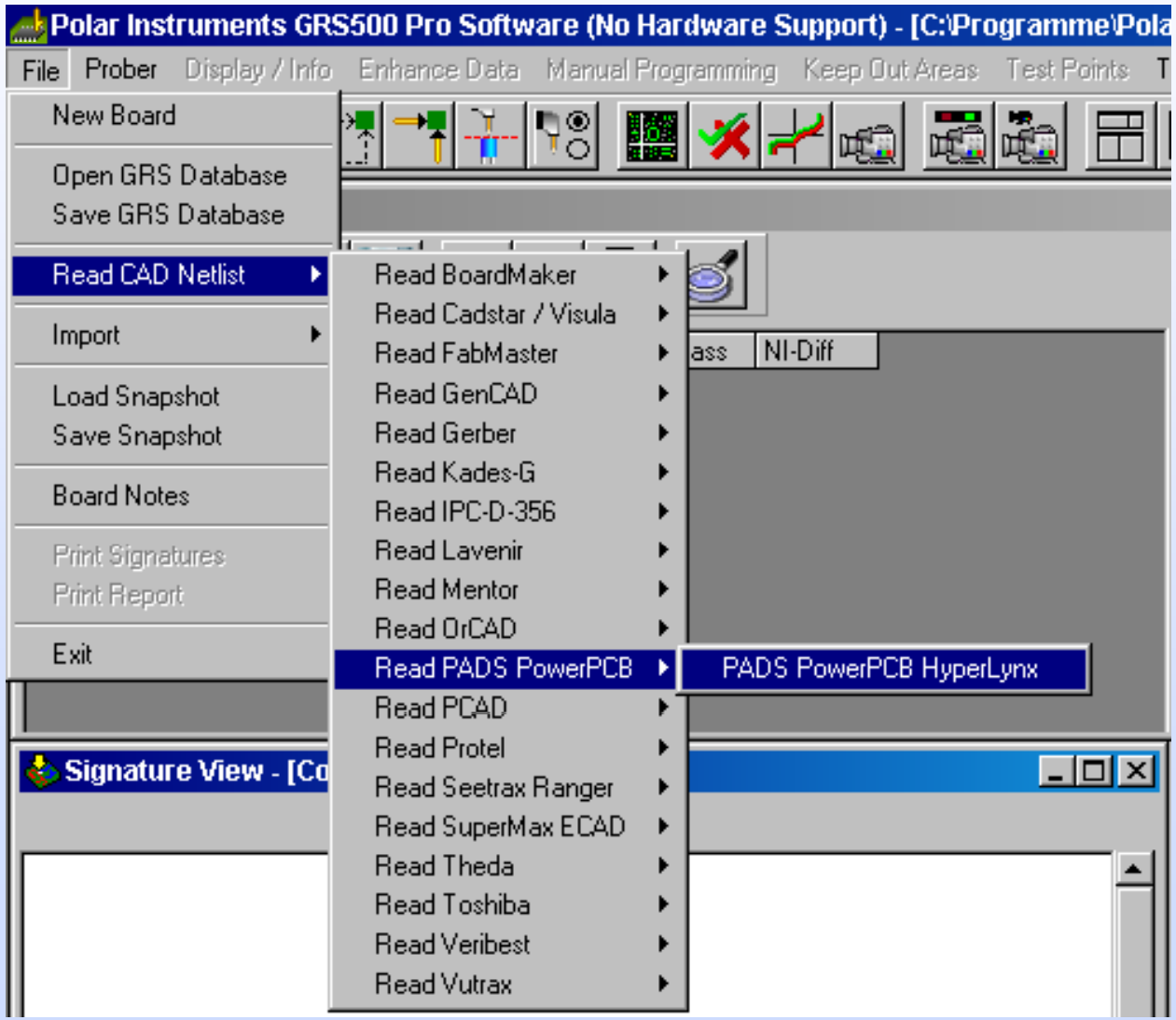


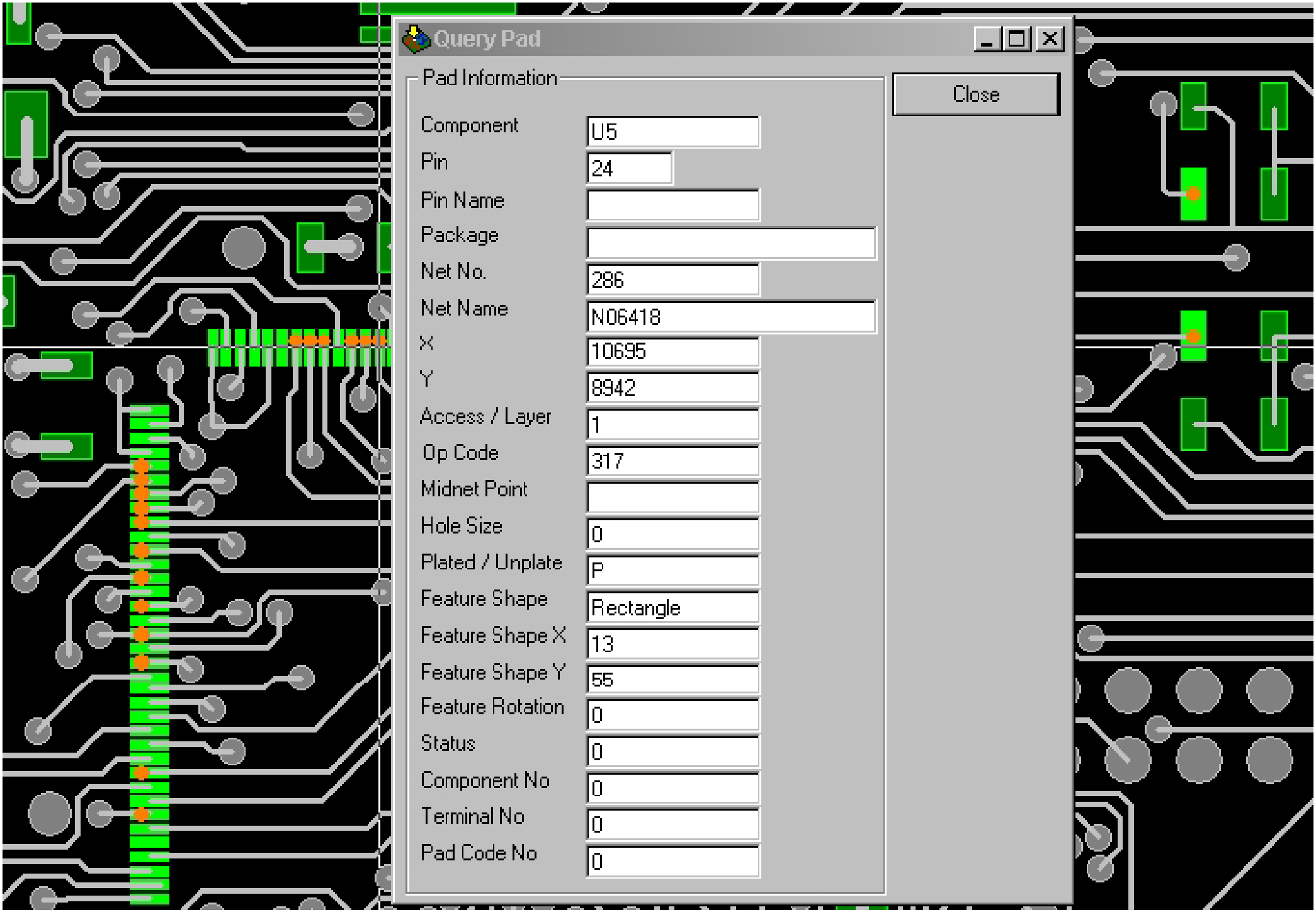
GRS500 Spezifikationen

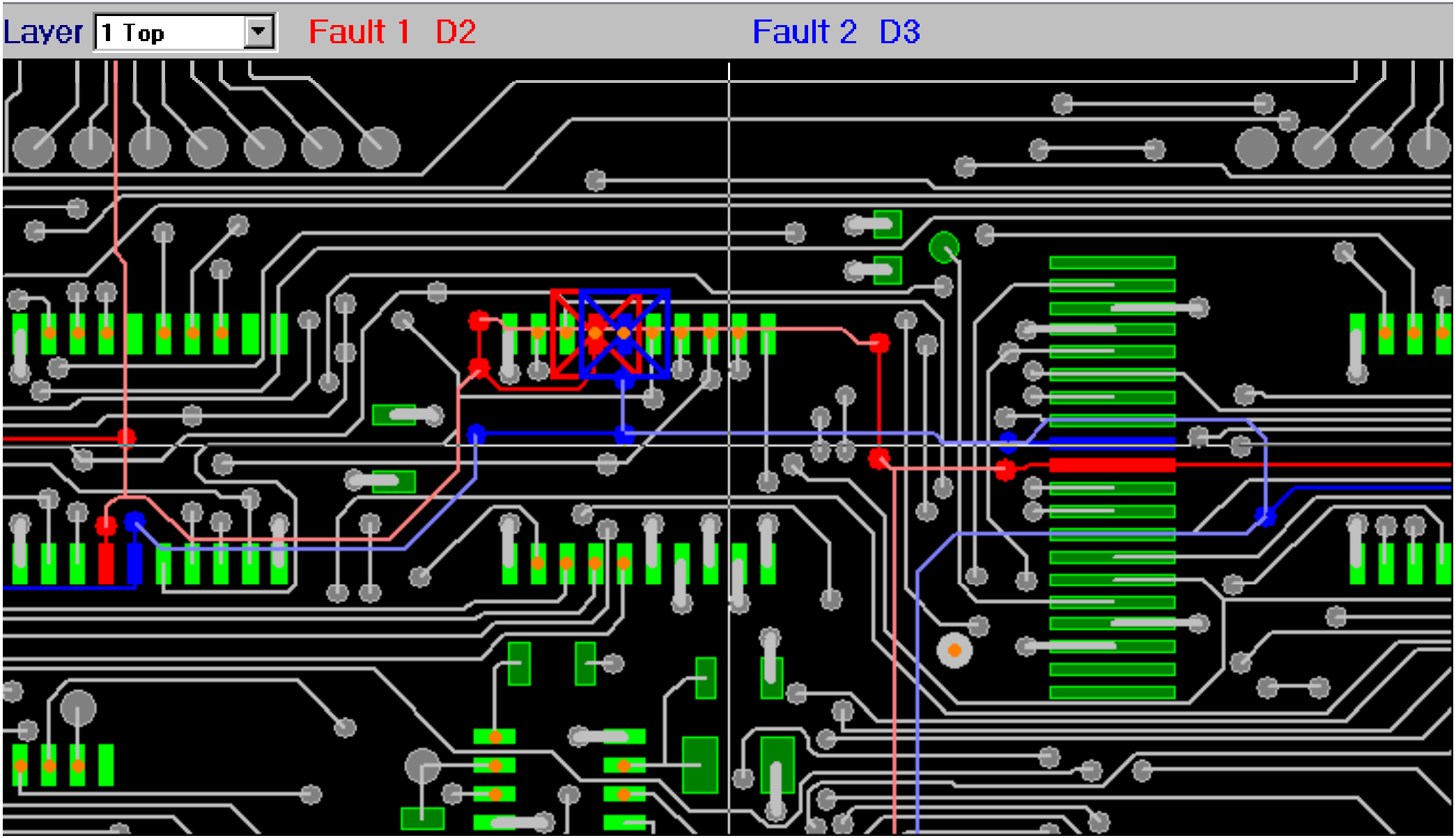
- 1 Testnadel, welche exakt 90° aufsetzt
- 40 µm Positioniergenauigkeit, 16 µm Auflösung
- Max. 5 Messpunkte/Sekunde
- Boardgrösse max. 33 x 63 cm
- Abtastfläche 30 x 45 cm
- 10 cm Z-Achsenhub
- Einfache Programmierung durch Joystick/Kamera oder CAD-Datenübernahme
- Kontaktierung von Fine-Pitch IC´s bis 0.4mm

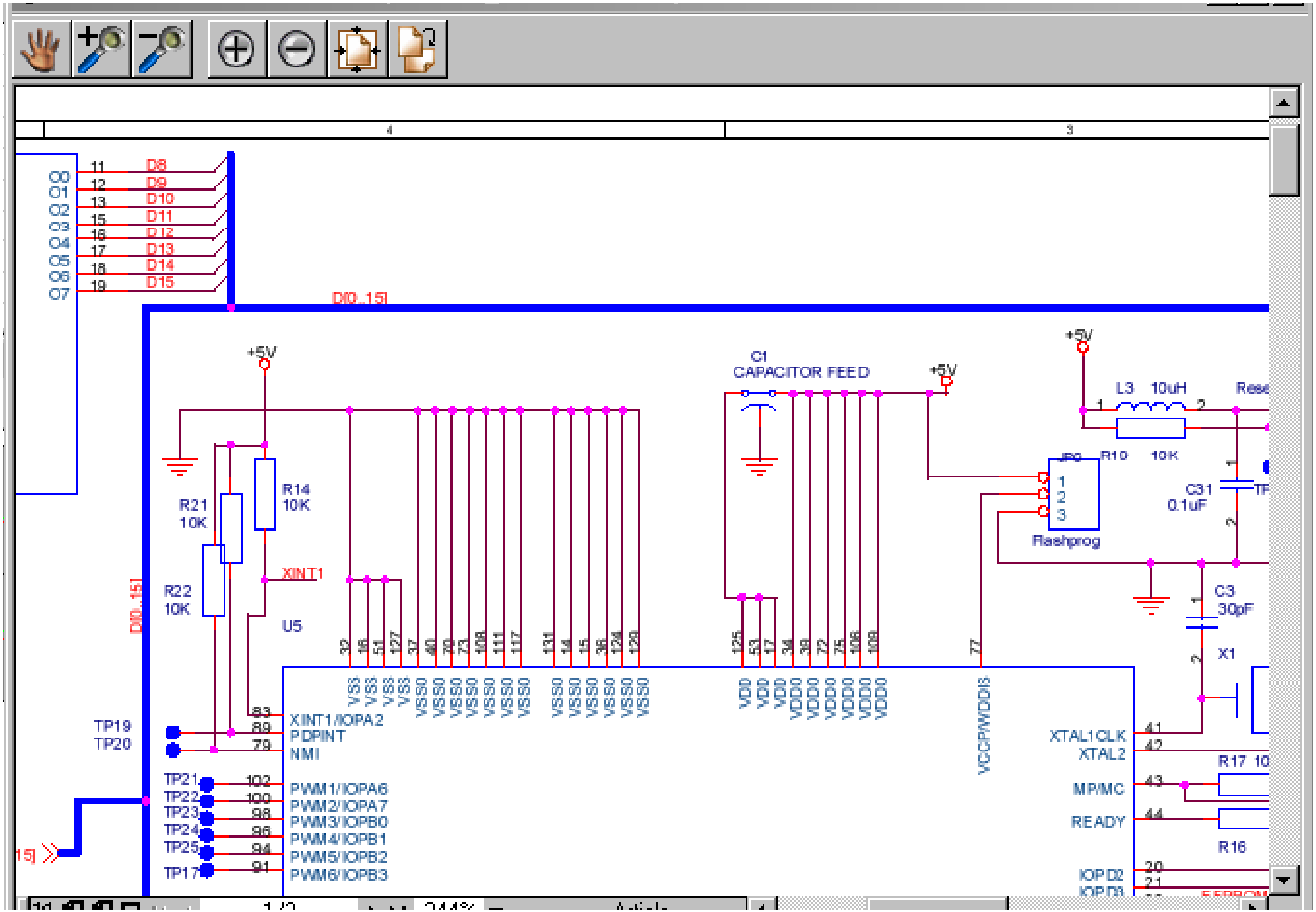

Polar Instruments GRS500 Pro Software (No Hardware Support) - [C:\Programme\Polar\GRS500 Demonstration\GRS500SampleBoard-Demo.grs]
File Prober Display / Info Enhance Data Manual Programming Keep Out Areas Test Points TestList Configure Window Help
Test List
Component Package Pins T/P NI-Pass NI-Diff
C8 2 1 1 0
R12 2 1 1 0
R11 2 1 1 0
U7 14 9 9 0
R13 2 1 1 0
U24 14 5 5 0
U41 20 8 8 0
U44 20 8 8 0
U45 20 8 8 0
U46 20 8 8 0
U41
Camera
Signature View - [U41]
U41 Pin 12 Junc Med 1%
U41 Pin 12 Log Med 1%
U41 Pin 12 Low Med 1%
U41 Pin 13 Junc Med 1%
U41 Pin 13 Log Med 1%
U41 Pin 13 Low Med 1%
U41 Pin 14 Junc Med 1%
U41 Pin 14 Log Med 1%
Board View
Layer 1 Top
Fault 1 D2
Fault 2 D3

CAD-Import

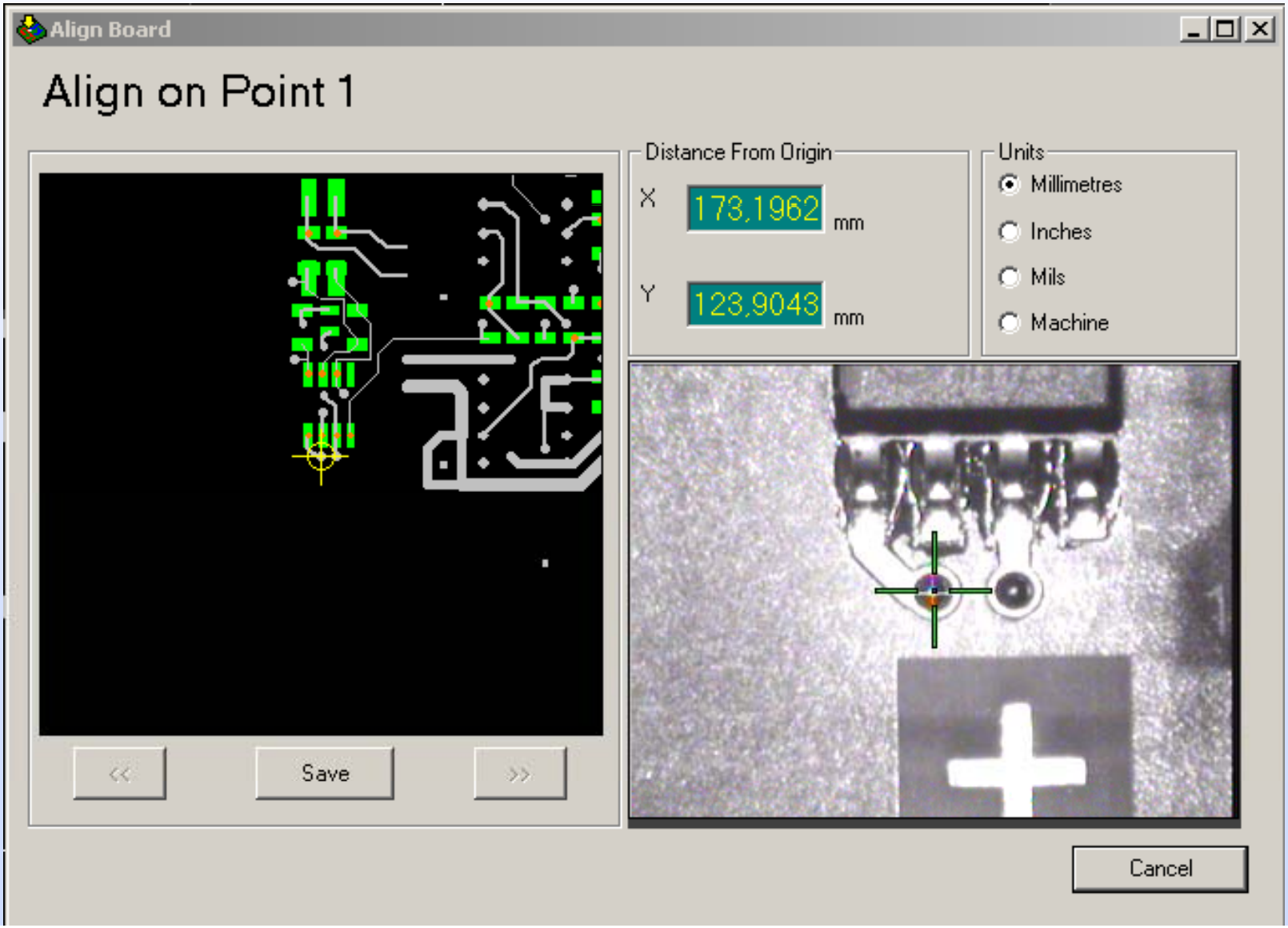

Polar Instruments GRS500 Pro Software (No Hardware Support) - [C:\Programme\Pola
File
Prober
Display / Info
Enhance Data
Manual Programming
Keep Out Areas
Test Points
New Board
Open GRS Database
Save GRS Database
Read CAD Netlist
Import
Load Snapshot
Save Snapshot
Board Notes
Print Signatures
Print Report
Exit
Read BoardMaker
Read Cadstar / Visula
Read FabMaster
Read GenCAD
Read Gerber
Read Kades-G
Read IPC-D-356
Read Lavenir
Read Mentor
Read OrCAD
Read PADS PowerPCB
Read PCAD
Read Protel
Read Seetrax Ranger
Read SuperMax ECAD
Read Theda
Read Toshiba
Read Veribest
Read Vutrax
PADS PowerPCB HyperLynx
ass
NI-Diff
Signature View - [Co


Query Pad
Pad Information
Close
Component
U5
Pin
24
Pin Name
Package
Net No.
286
Net Name
N06418
X
10695
Y
8942
Access / Layer
1
Op Code
317
Midnet Point
Hole Size
0
Plated / Unplate
P
Feature Shape
Rectangle
Feature Shape X
13
Feature Shape Y
55
Feature Rotation
0
Status
0
Component No
0
Terminal No
0
Pad Code No
0

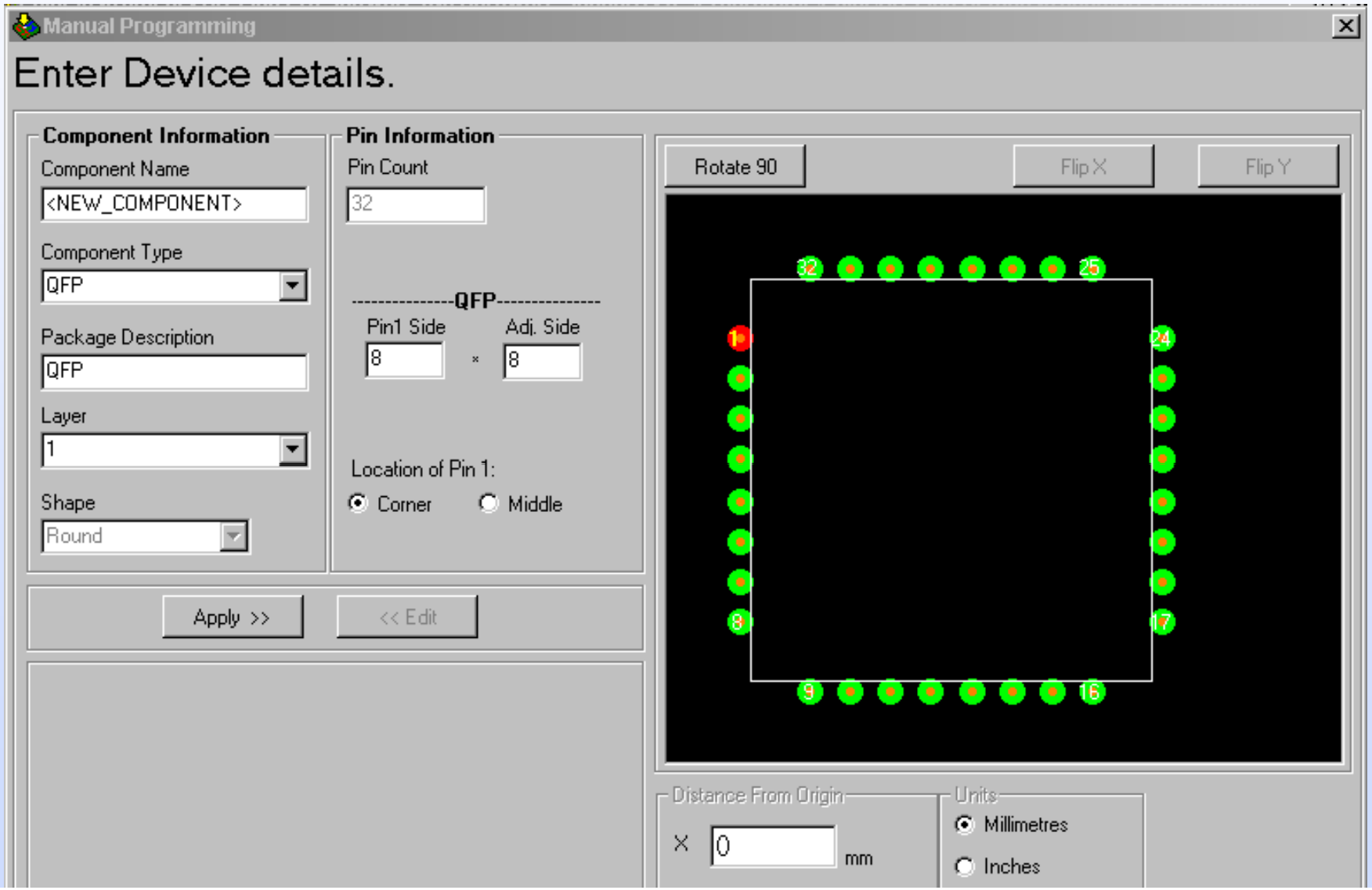

Layer
1 Top
Fault 1 D2
Fault 2 D3


D0
D1
D2
D3
D4
D5
D6
D7
11
12
13
15
16
17
18
19
D8
D9
D10
D11
D12
D13
D14
D15
D[0..15]
+5V
R21
10K
R22
10K
R14
10K
XINT1
U5
C1
CAPACITOR FEED
L3 10uH
R10
10K
Flashprog
C31
0.1uF
C3
30pF
X1
R17 10
R16
TP19
TP20
TP21
TP22
TP23
TP24
TP25
TP17
XINT1/IOPA2
PDPINT
NMI
PWM1/IOPA6
PWM2/IOPA7
PWM3/IOPB0
PWM4/IOPB1
PWM5/IOPB2
PWM6/IOPB3
VSS
VDD
VCCP/WDDIS
XTAL1CLK
XTAL2
MP/MC
READY
IOPD2
IOPD3

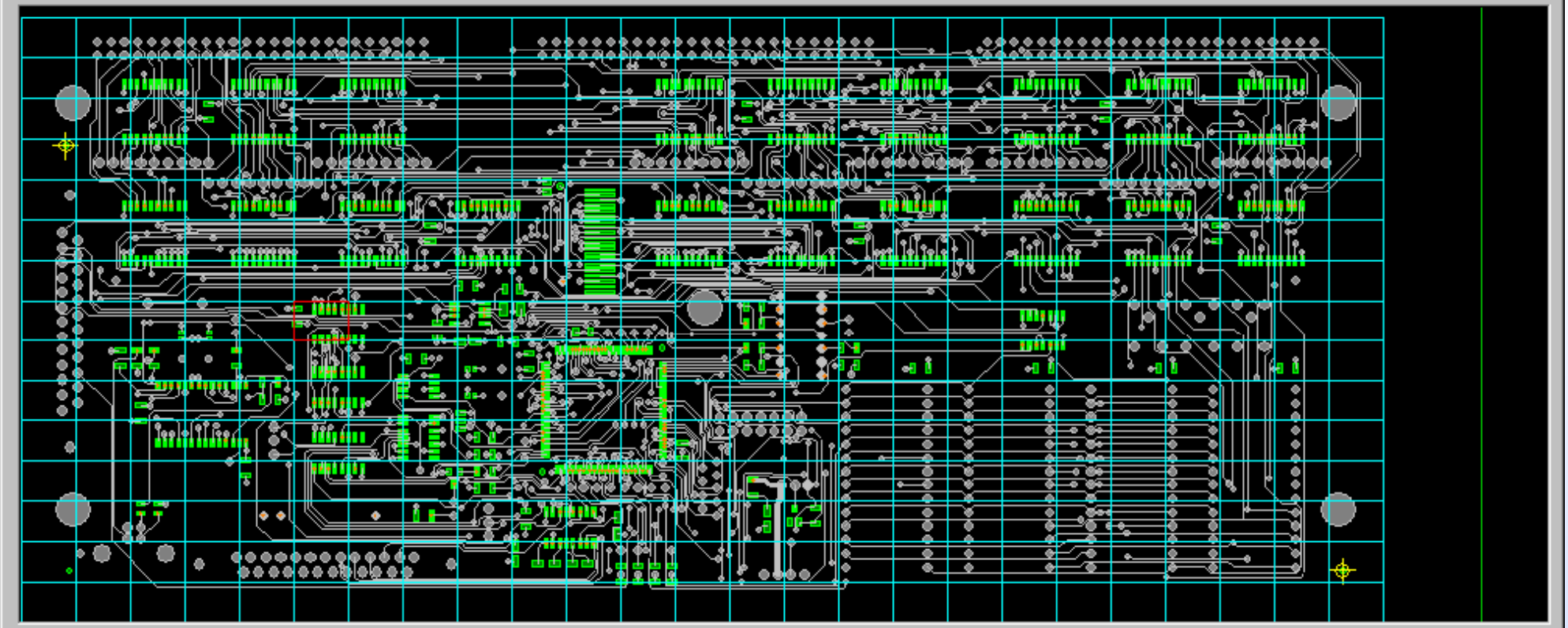
Baugruppenabgleich auf Referenzmarken



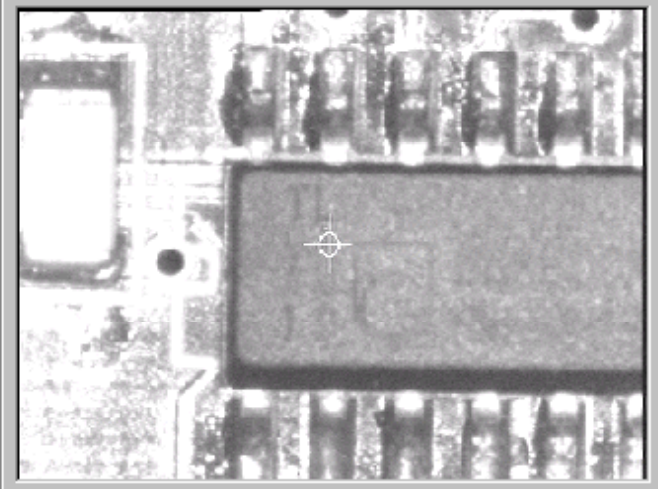
Manuelle Programmierung



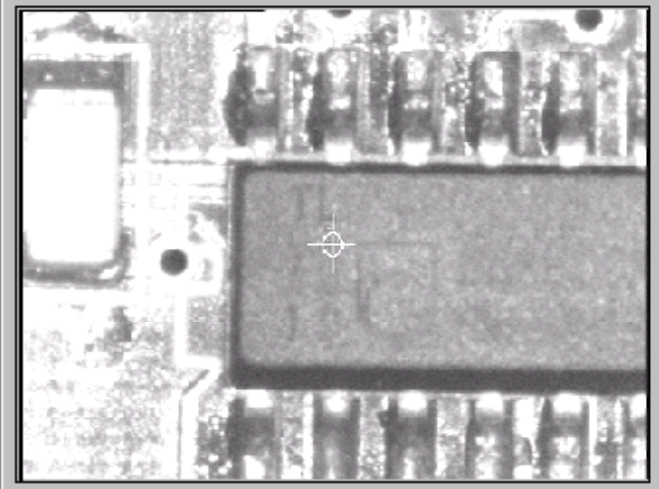
File Frames



Learnt View



Current View



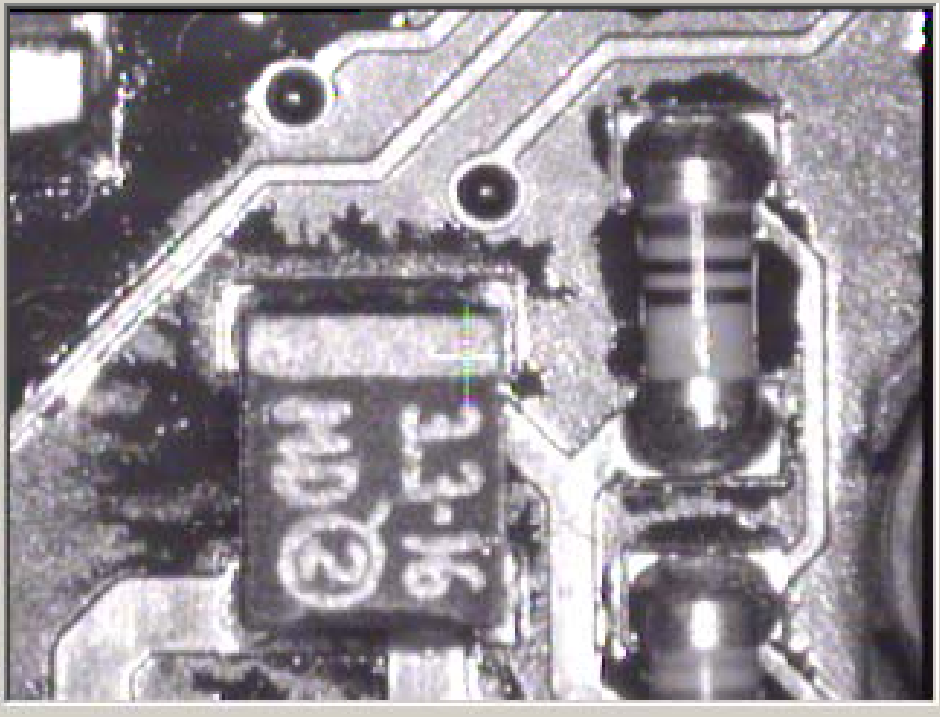
|< << >> >|

Close

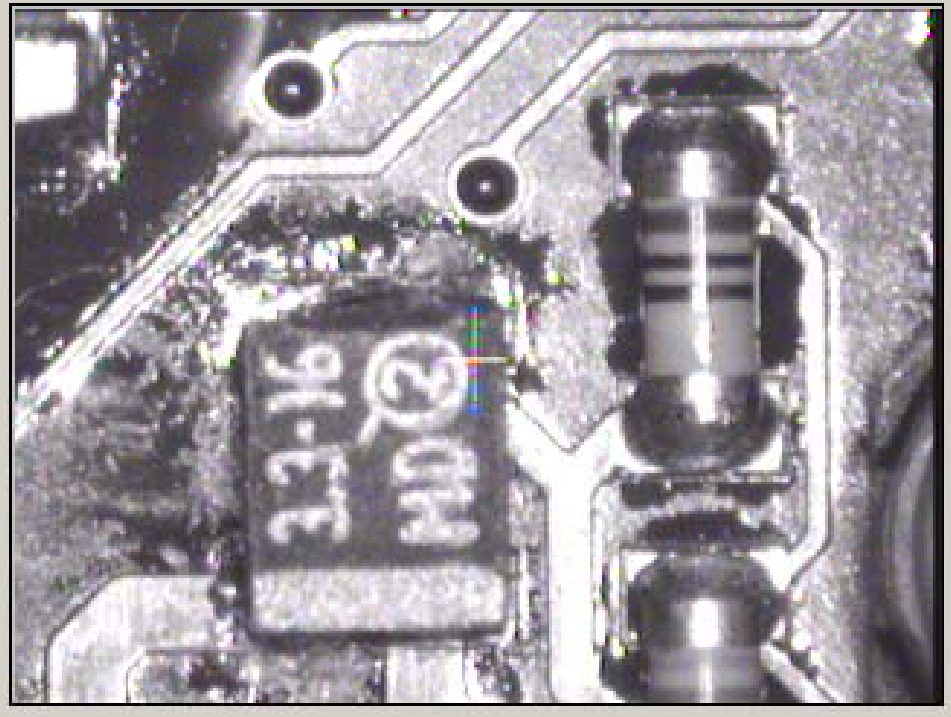
Notes (Enter Note before selecting Add Frame)

Verpolter Kondensator

Learnt View

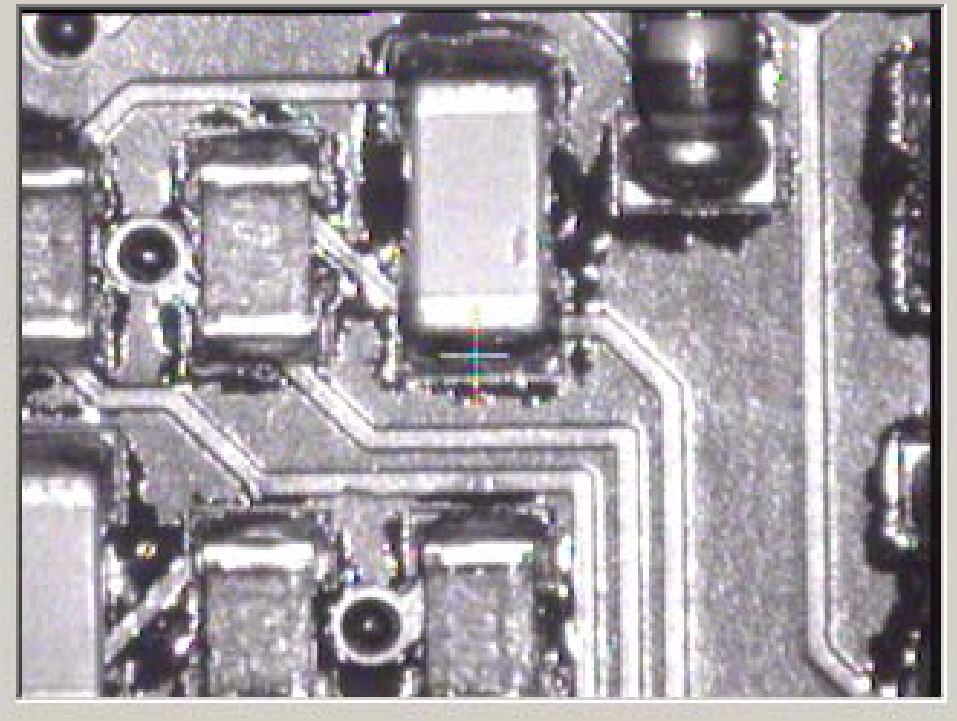


Current View

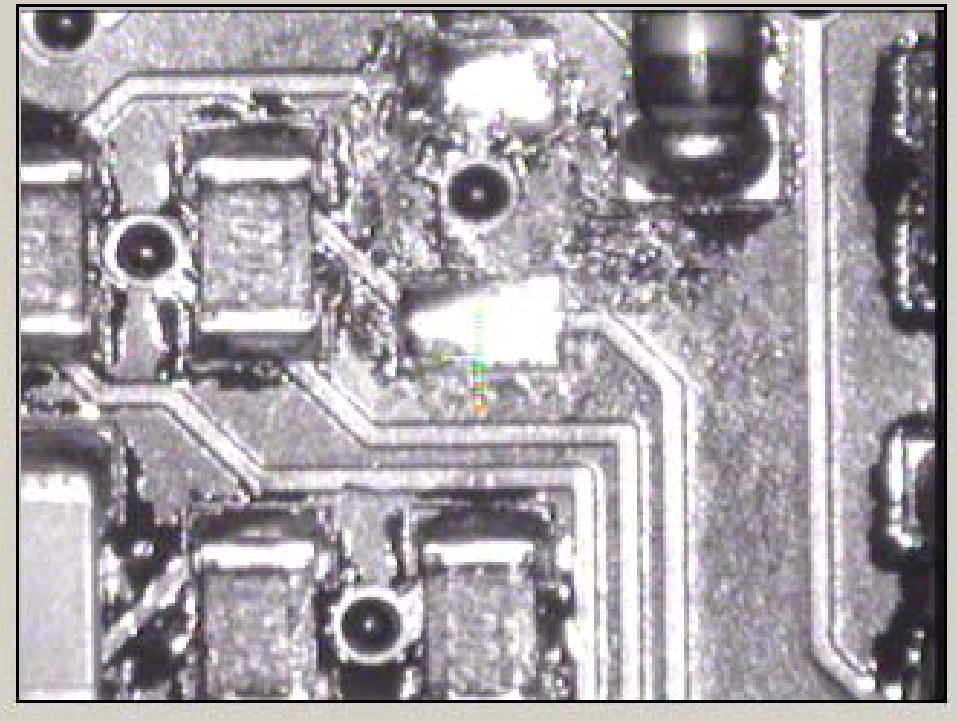


Fehlender Kondensator

Learnt View

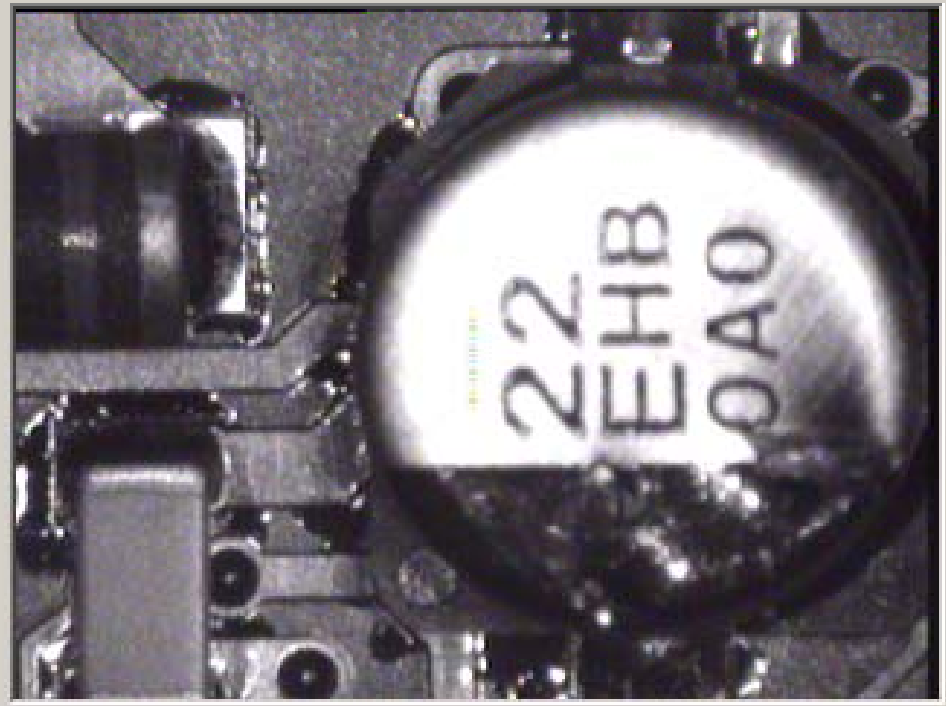


Current View

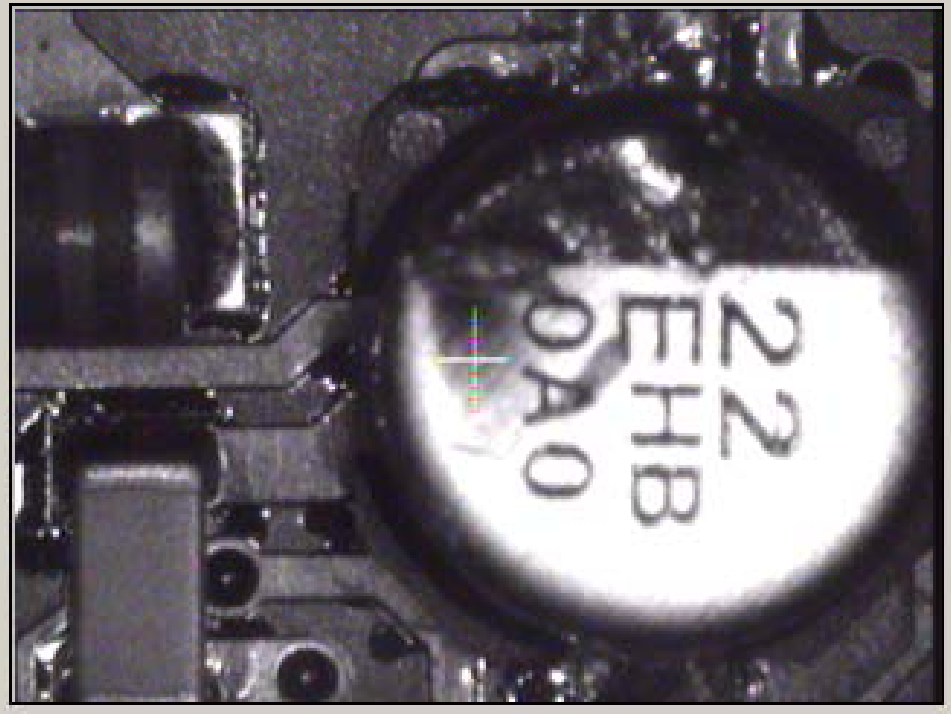


Verpolter Kondensator

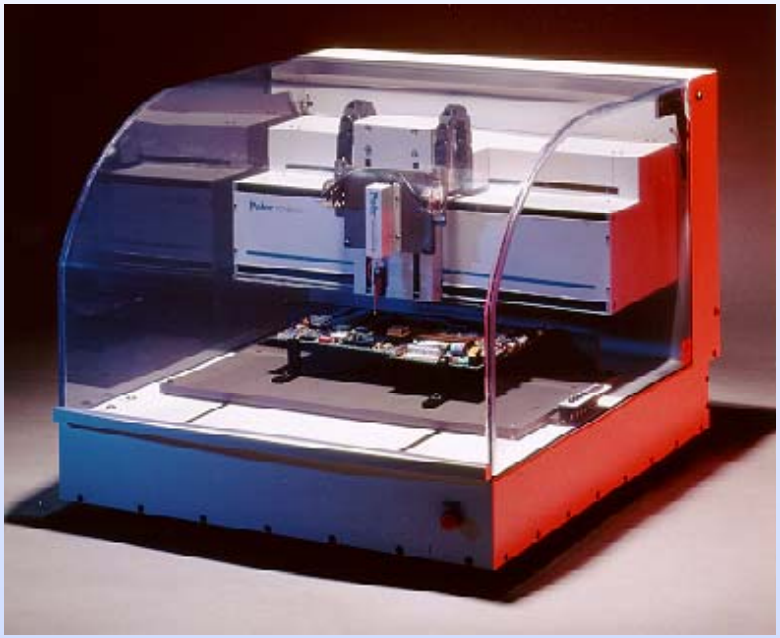
Learnt View

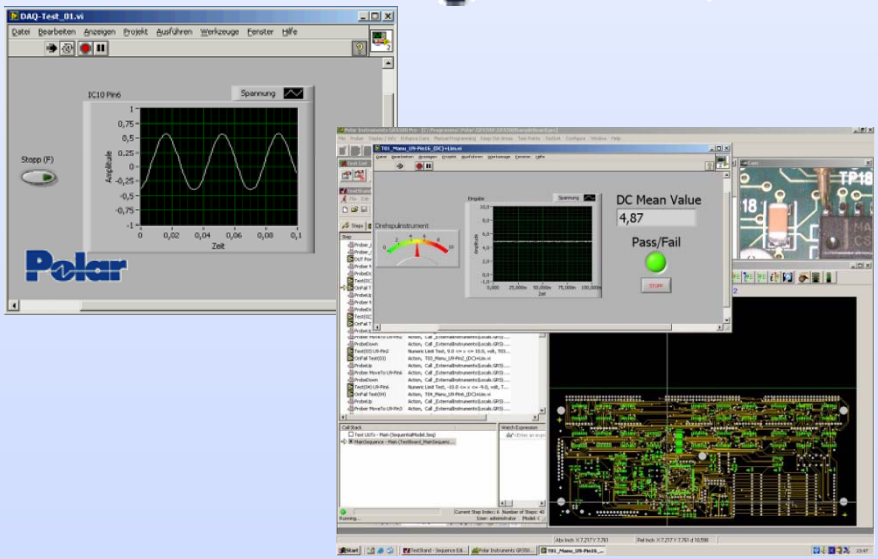


Current View

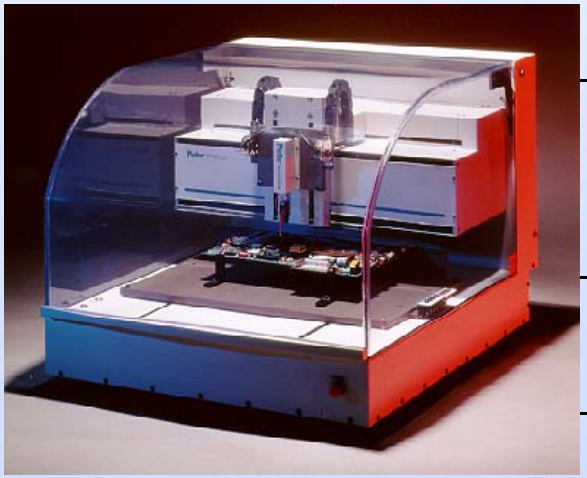


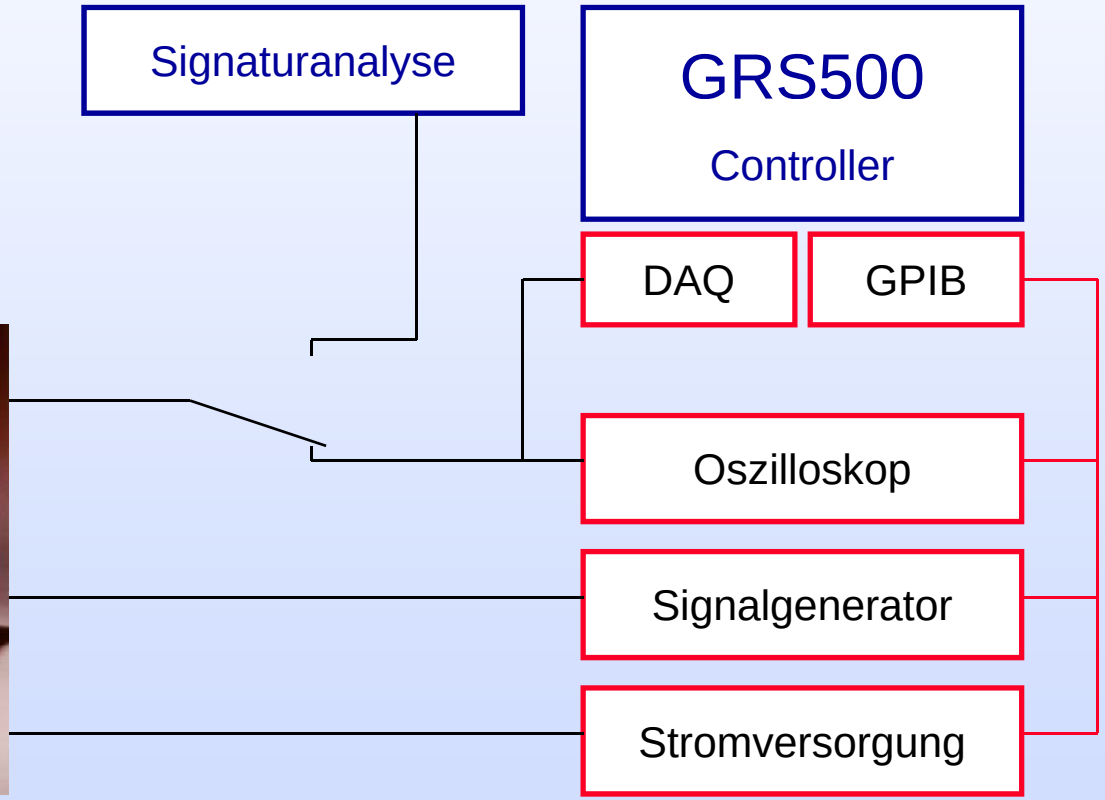
GRS500 ActiveTest Option





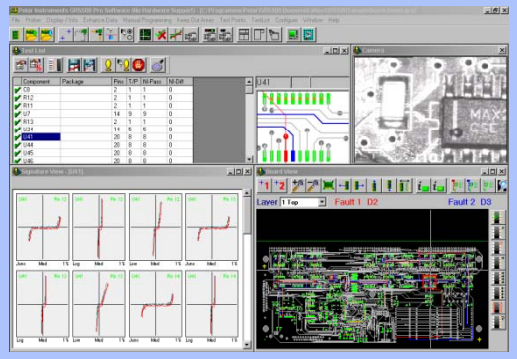
GRS500 ActiveTest Option



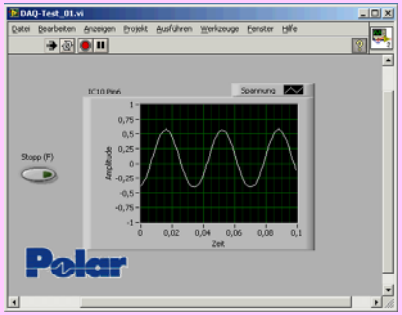


GRS500 Controller

GRS500 Software



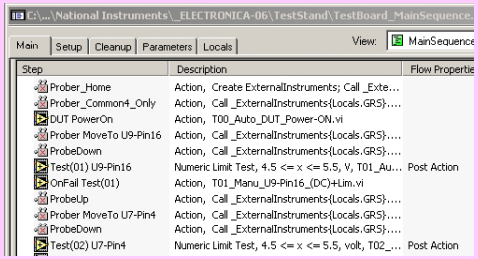
National Instruments LabView



GPIB

USB

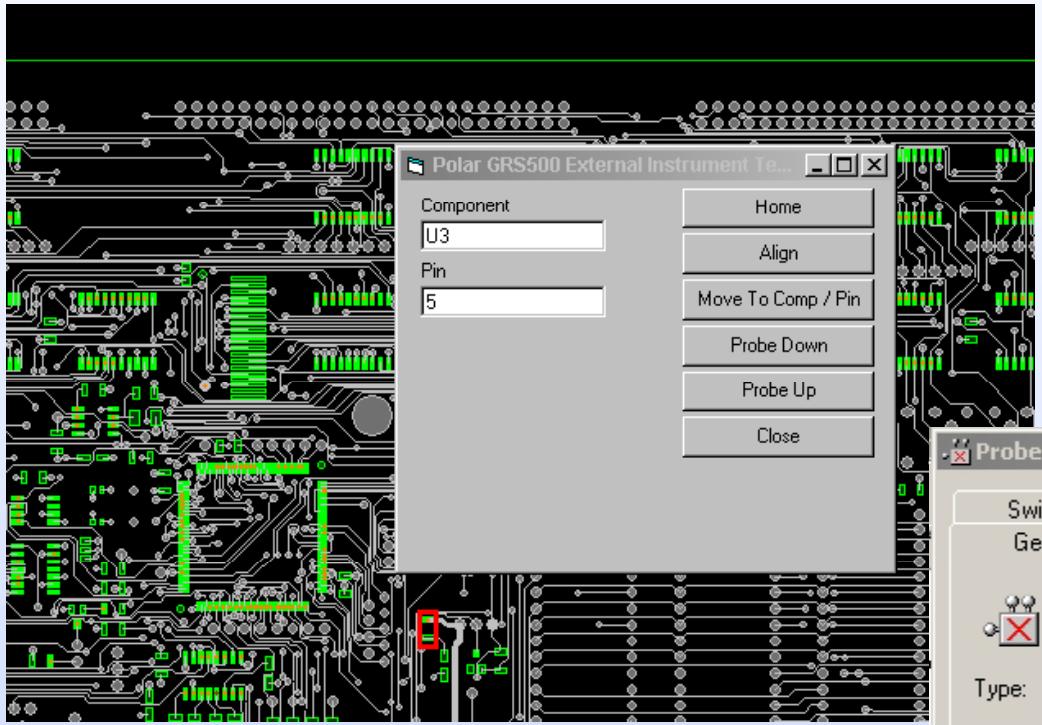
National Instruments TestStand



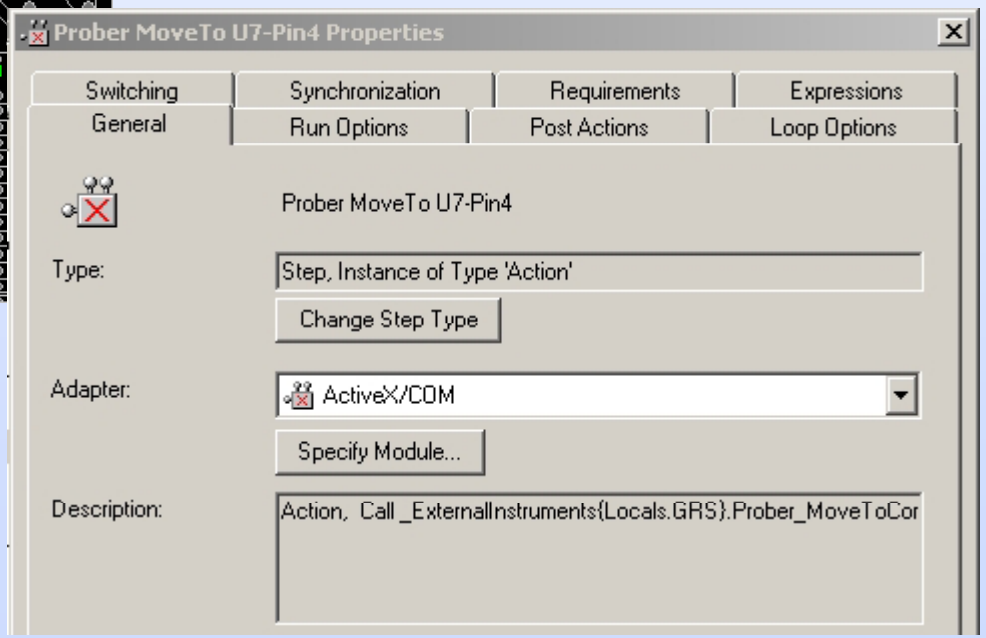
RS232

PCI

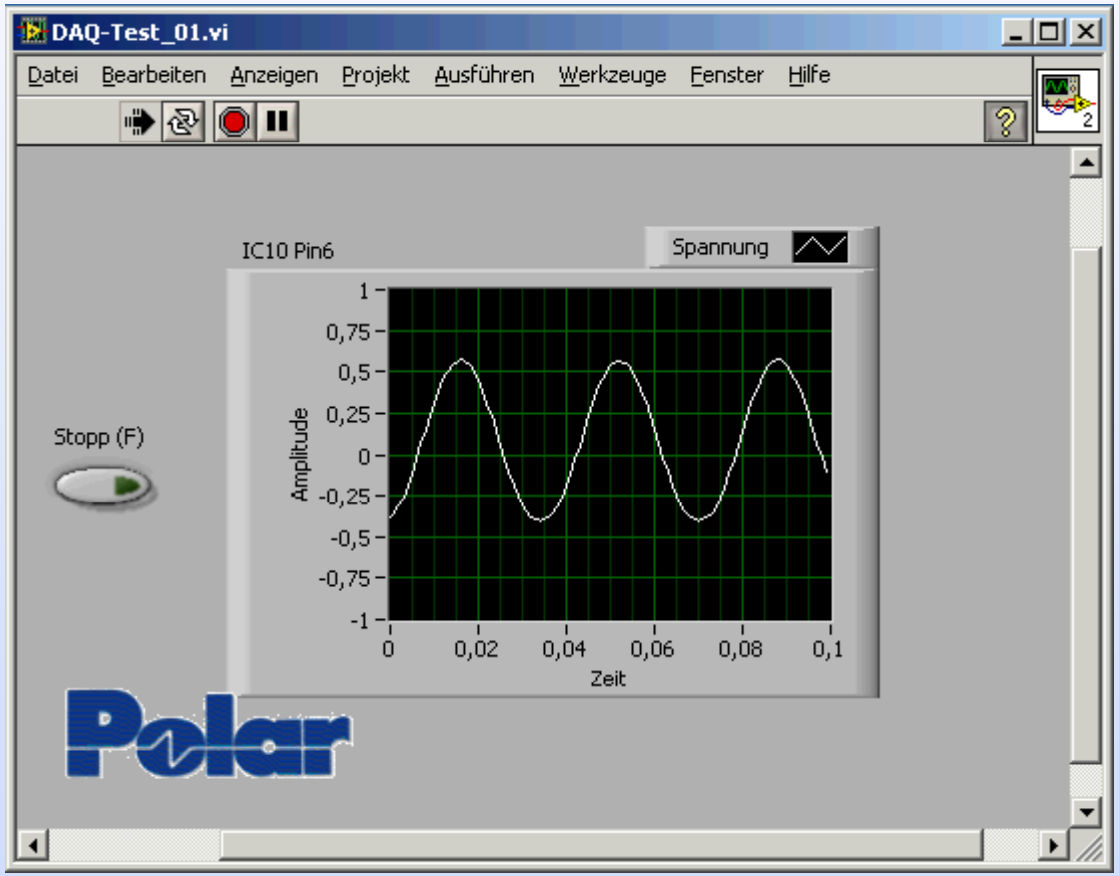
GRS500 External Instruments



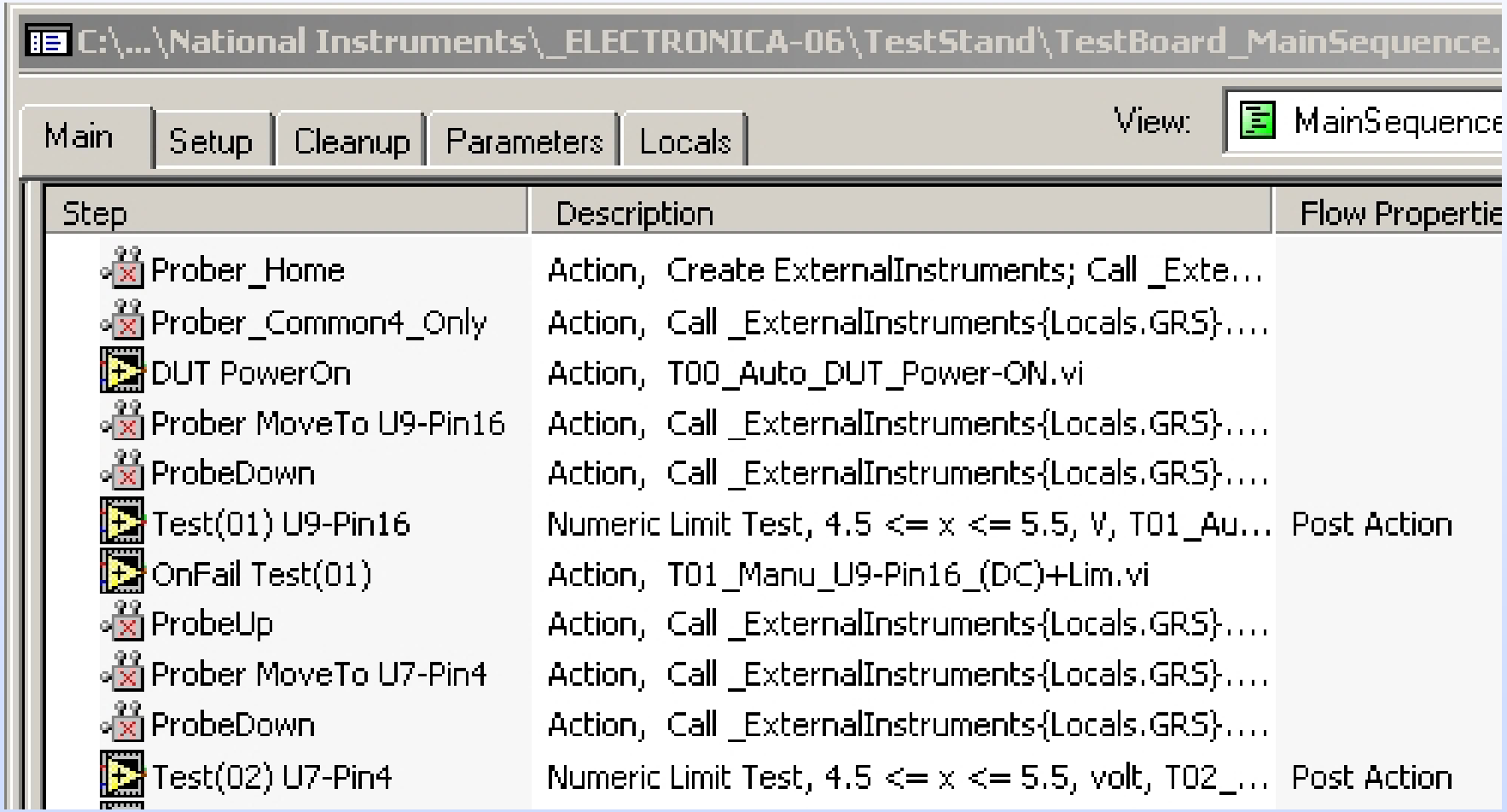
NI TestStand

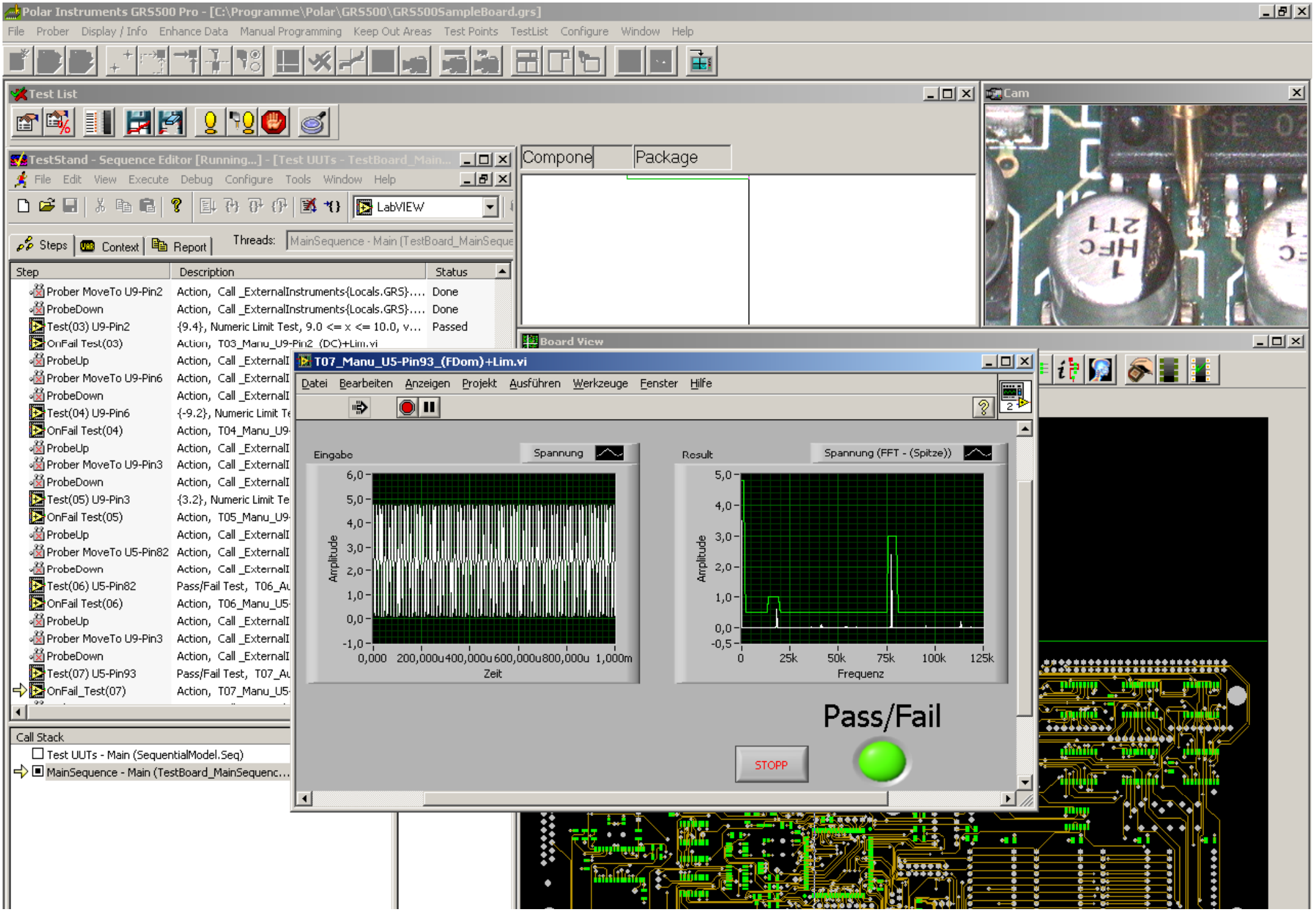


LabView


DAQ-Test_01.vi
Datei Bearbeiten Anzeigen Projekt Ausführen Werkzeuge Fenster Hilfe
IC10 Pin6
Spannung
Stopp (F)
Amplitude
1
0,75
0,5
0,25
0
-0,25
-0,5
-0,75
-1
0
0,02
0,04
0,06
0,08
0,1
Zeit
Polar

TestStand

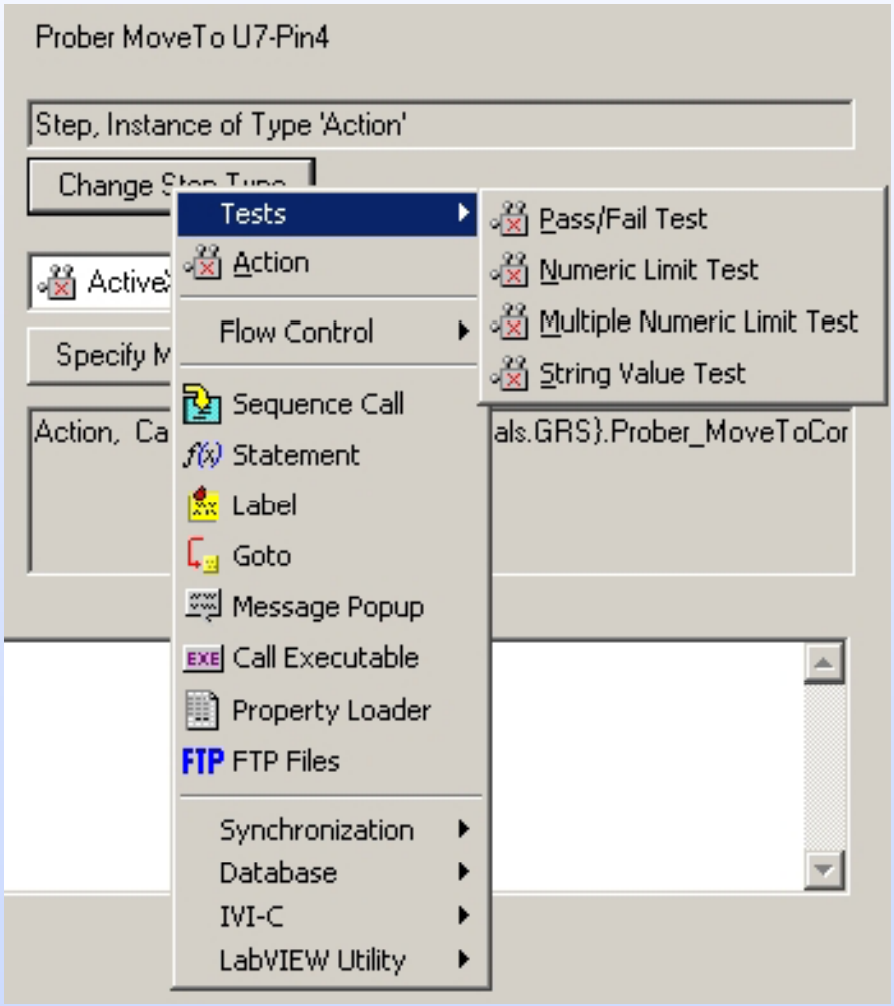

C:\...\National Instruments_ELECTRONICA-06\TestStand\TestBoard_MainSequence.
Main
Setup
Cleanup
Parameters
Locals
View:
MainSequence
Step
Description
Flow Propertie
Prober_Home
Action, Create ExternalInstruments; Call _Exte...
Prober_Common4_Only
Action, Call _ExternalInstruments{Locals.GRS}....
DUT PowerOn
Action, T00_Auto_DUT_Power-ON.vi
Prober MoveTo U9-Pin16
Action, Call _ExternalInstruments{Locals.GRS}....
ProbeDown
Action, Call _ExternalInstruments{Locals.GRS}....
Test(01) U9-Pin16
Numeric Limit Test, 4.5 <= x <= 5.5, V, T01_Au...
Post Action
OnFail Test(01)
Action, T01_Manu_U9-Pin16_(DC)+Lim.vi
ProbeUp
Action, Call _ExternalInstruments{Locals.GRS}....
Prober MoveTo U7-Pin4
Action, Call _ExternalInstruments{Locals.GRS}....
ProbeDown
Action, Call _ExternalInstruments{Locals.GRS}....
Test(02) U7-Pin4
Numeric Limit Test, 4.5 <= x <= 5.5, volt, T02_...
Post Action


Polar Instruments GR5500 Pro - [C:\Programme\Polar\GR5500\GR5500SampleBoard.grs]
File Prober Display / Info Enhance Data Manual Programming Keep Out Areas Test Points TestList Configure Window Help
Test List
TestStand - Sequence Editor [Running...] - [Test UUTs - TestBoard_Main...
File Edit View Execute Debug Configure Tools Window Help
LabVIEW
Steps Context Report Threads: MainSequence - Main (TestBoard_MainSeque
Step Description Status
Prober MoveTo U9-Pin2 Action, Call _ExternalInstruments{Locals.GRS}.... Done
ProbeDown Action, Call _ExternalInstruments{Locals.GRS}.... Done
Test(03) U9-Pin2 {9.4}, Numeric Limit Test, 9.0 <= x <= 10.0, v... Passed
OnFail Test(03) Action, T03_Manu_U9-Pin2_(DC)+Lim.vi
ProbeUp Action, Call _ExternalI
Prober MoveTo U9-Pin6 Action, Call _ExternalI
ProbeDown Action, Call _ExternalI
Test(04) U9-Pin6 {-9.2}, Numeric Limit Te
OnFail Test(04) Action, T04_Manu_U9-
ProbeUp Action, Call _ExternalI
Prober MoveTo U9-Pin3 Action, Call _ExternalI
ProbeDown Action, Call _ExternalI
Test(05) U9-Pin3 {3.2}, Numeric Limit Te
OnFail Test(05) Action, T05_Manu_U9-
ProbeUp Action, Call _ExternalI
Prober MoveTo U5-Pin82 Action, Call _ExternalI
ProbeDown Action, Call _ExternalI
Test(06) U5-Pin82 Pass/Fail Test, T06_Au
OnFail Test(06) Action, T06_Manu_U5-
ProbeUp Action, Call _ExternalI
Prober MoveTo U9-Pin3 Action, Call _ExternalI
ProbeDown Action, Call _ExternalI
Test(07) U5-Pin93 Pass/Fail Test, T07_Au
OnFail_Test(07) Action, T07_Manu_U5-
Call Stack
Test UUTs - Main (SequentialModel.Seq)
MainSequence - Main (TestBoard_MainSequenc...
Compone
Package
Cam
Board View
T07_Manu_U5-Pin93_(FDom)+Lim.vi
Datei Bearbeiten Anzeigen Projekt Ausführen Werkzeuge Fenster Hilfe
Eingabe
Spannung
Amplitude
6,0
5,0
4,0
3,0
2,0
1,0
0,0
-1,0
0,000 200,000u 400,000u 600,000u 800,000u 1,000m
Zeit
Result
Spannung (FFT - (Spitze))
Amplitude
5,0
4,0
3,0
2,0
1,0
0,0
-0,5
0 25k 50k 75k 100k 125k
Frequenz
Pass/Fail
STOPP

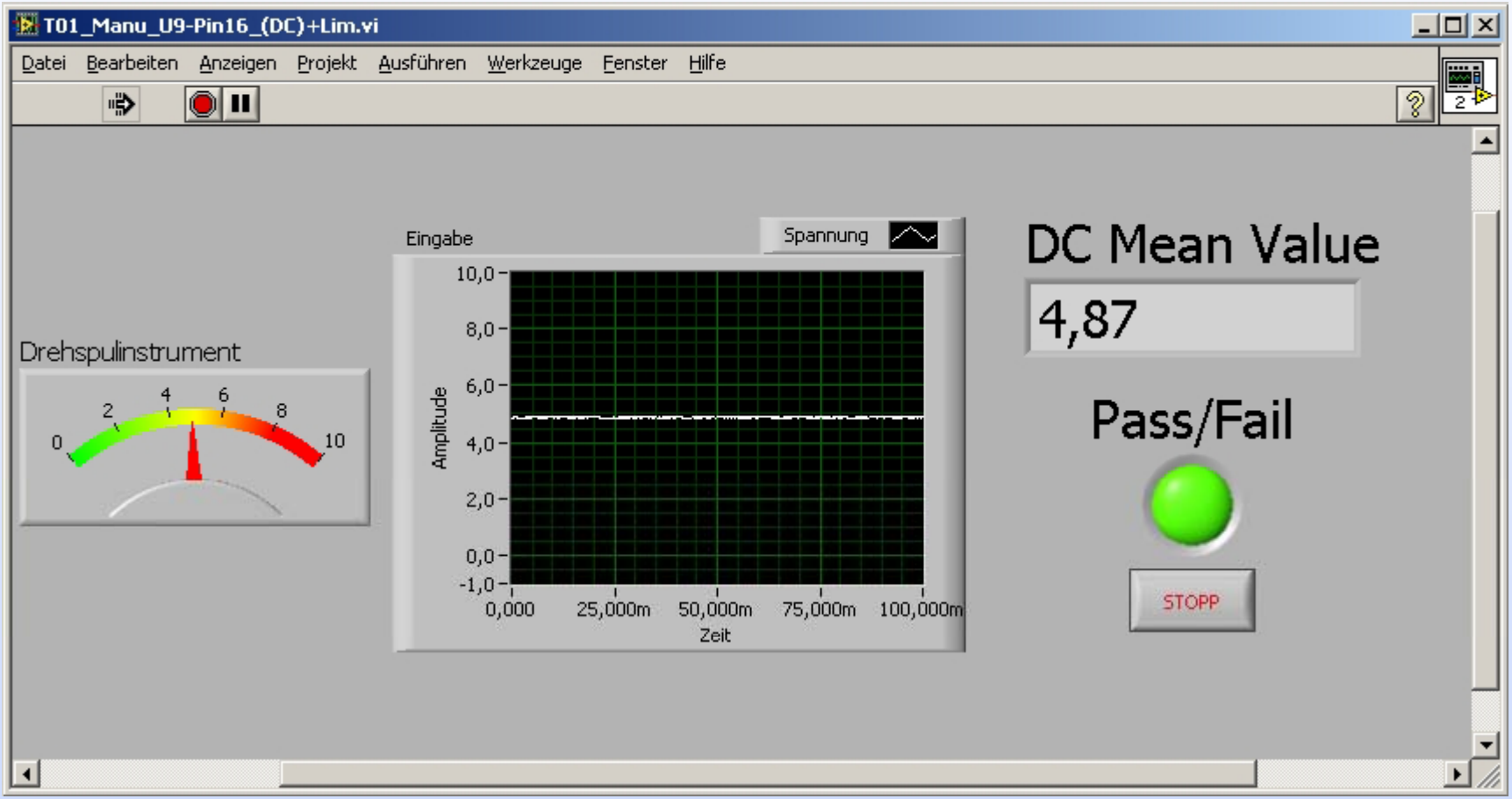
ActiveTest

- DC-Messung
- AC-Messung
- Kurvenformverlauf
- Toleranzlimits, Gut/Schlecht-Vergleich
- FFT Spektrumanalyse
- Signalgenerator
- Digital I/O Ports zur Steuerung des Messobjekts
- Einbindung von weiteren Geräten via GPIB, RS232, USB, PCI

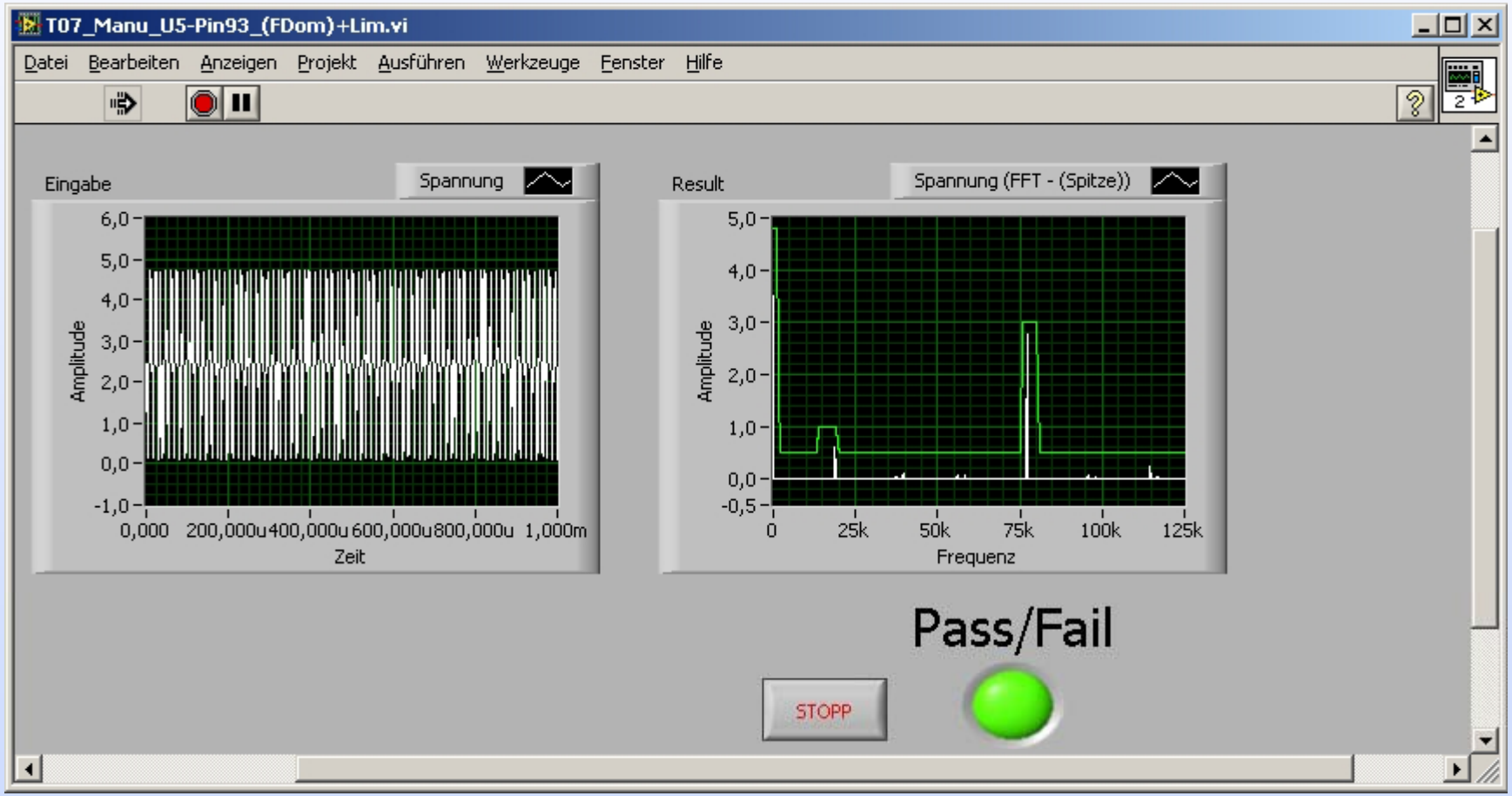
ActiveTest


Prober MoveTo U7-Pin4
Step, Instance of Type 'Action'
Change Step Type
Tests
Action
Flow Control
Sequence Call
Statement
Label
Goto
Message Popup
Call Executable
Property Loader
FTP Files
Synchronization
Database
IVI-C
LabVIEW Utility
Pass/Fail Test
Numeric Limit Test
Multiple Numeric Limit Test
String Value Test
Specify M
Action, Ca
als.GRS}.Prober_MoveToCor

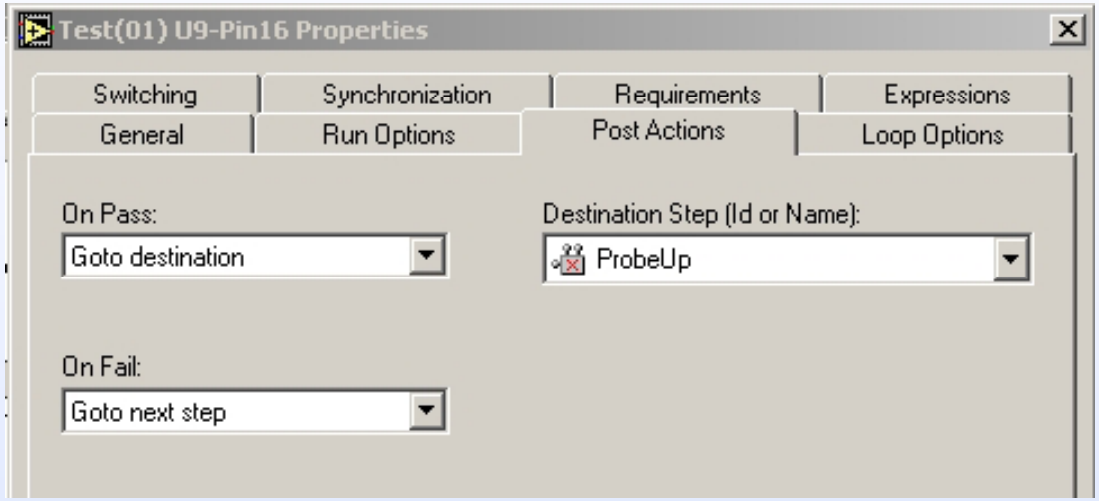
DC Messung


T01_Manu_U9-Pin16_(DC)+Lim.vi
Datei Bearbeiten Anzeigen Projekt Ausführen Werkzeuge Fenster Hilfe
Drehspulinstrument
0 2 4 6 8 10
Eingabe
Spannung
Amplitude
10,0 8,0 6,0 4,0 2,0 0,0 -1,0
0,000 25,000m 50,000m 75,000m 100,000m
Zeit
DC Mean Value
4,87
Pass/Fail
STOPP

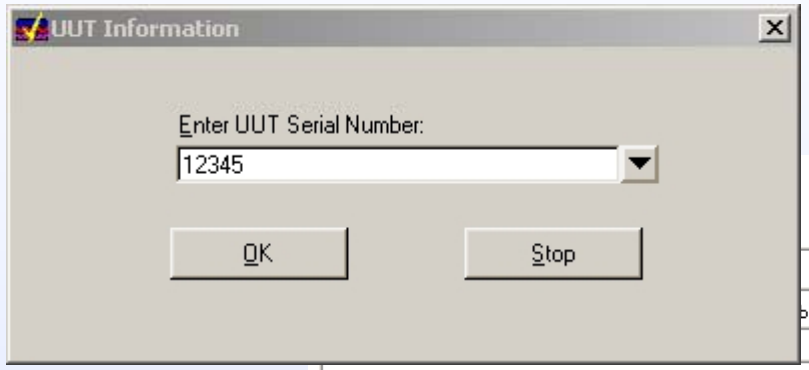
FFT Analyse


T07_Manu_U5-Pin93_(FDom)+Lim.vi
Datei Bearbeiten Anzeigen Projekt Ausführen Werkzeuge Fenster Hilfe
Eingabe
Spannung
Amplitude
6,0
5,0
4,0
3,0
2,0
1,0
0,0
-1,0
0,000 200,000u 400,000u 600,000u 800,000u 1,000m
Zeit
Result
Spannung (FFT - (Spitze))
Amplitude
5,0
4,0
3,0
2,0
1,0
0,0
-0,5
0 25k 50k 75k 100k 125k
Frequenz
Pass/Fail
STOPP

Bedingte Sprungbefehle



Gut/Schlecht Vergleich



Dokumentation

	Time	Operator	Execution Time	Number of Results	UUT Result
ber 2006	13:03:51	administrator	98.1394582 seconds	7	Failed

Failure Chain		
Step	**Sequence**	**Sequence File**
Test(06) U5-Pin82	MainSequence	TestBoard_MainSequence.seq

Begin Sequence: MainSequence
(C:\Programme\National Instruments_ELECTRONICA-06\TestStand\TestBoard_MainSequence.seq)

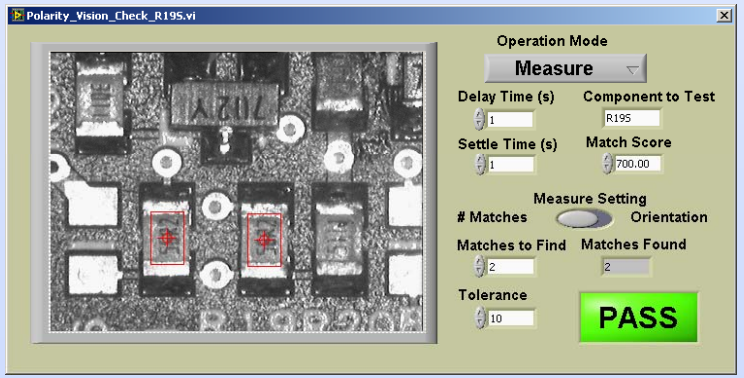
Step	Status	Measurement	Units	Limits		
				Low Limit	High Limit	Comparison Type
Test(01) U9-Pin16	Passed	4.9	V	4.5	5.5	GELE(>= <=)
Test(02) U7-Pin4	Passed	5.0	volt	4.5	5.5	GELE(>= <=)
Test(03) U9-Pin2	Passed	9.4	volt	9.0	10.0	GELE(>= <=)
Test(04) U9-Pin6	Passed	-9.2	volt	-10.0	-9.0	GELE(>= <=)
Test(05) U9-Pin3	Passed	3.2	volt rms	2.5	3.5	GELE(>= <=)
Test(06) U5-Pin82	Failed					
Test(07) U5-Pin93	Failed					

End Sequence: MainSequence

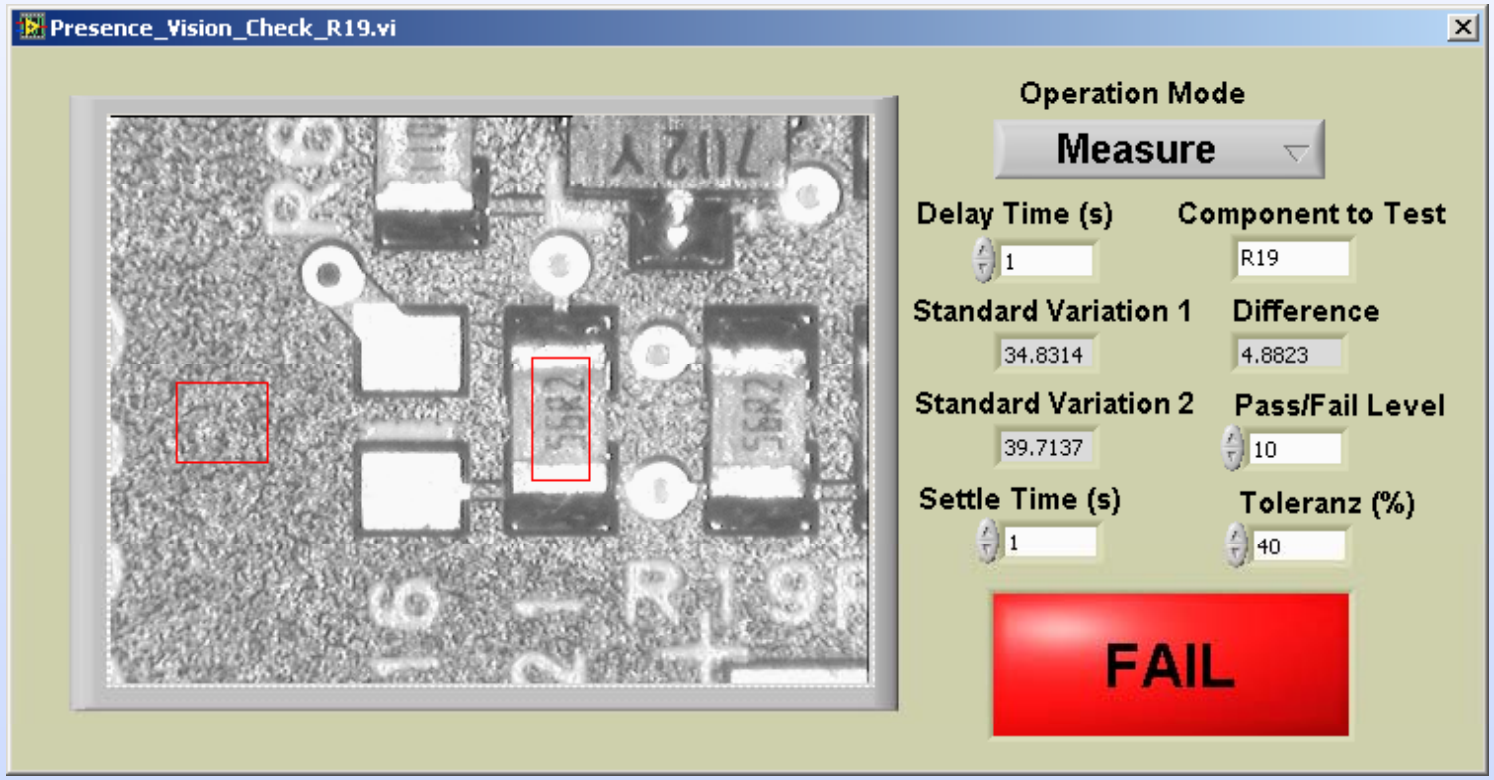
End UUT Report

ActiveVision
Zusatzmodul zu **ActiveTest**

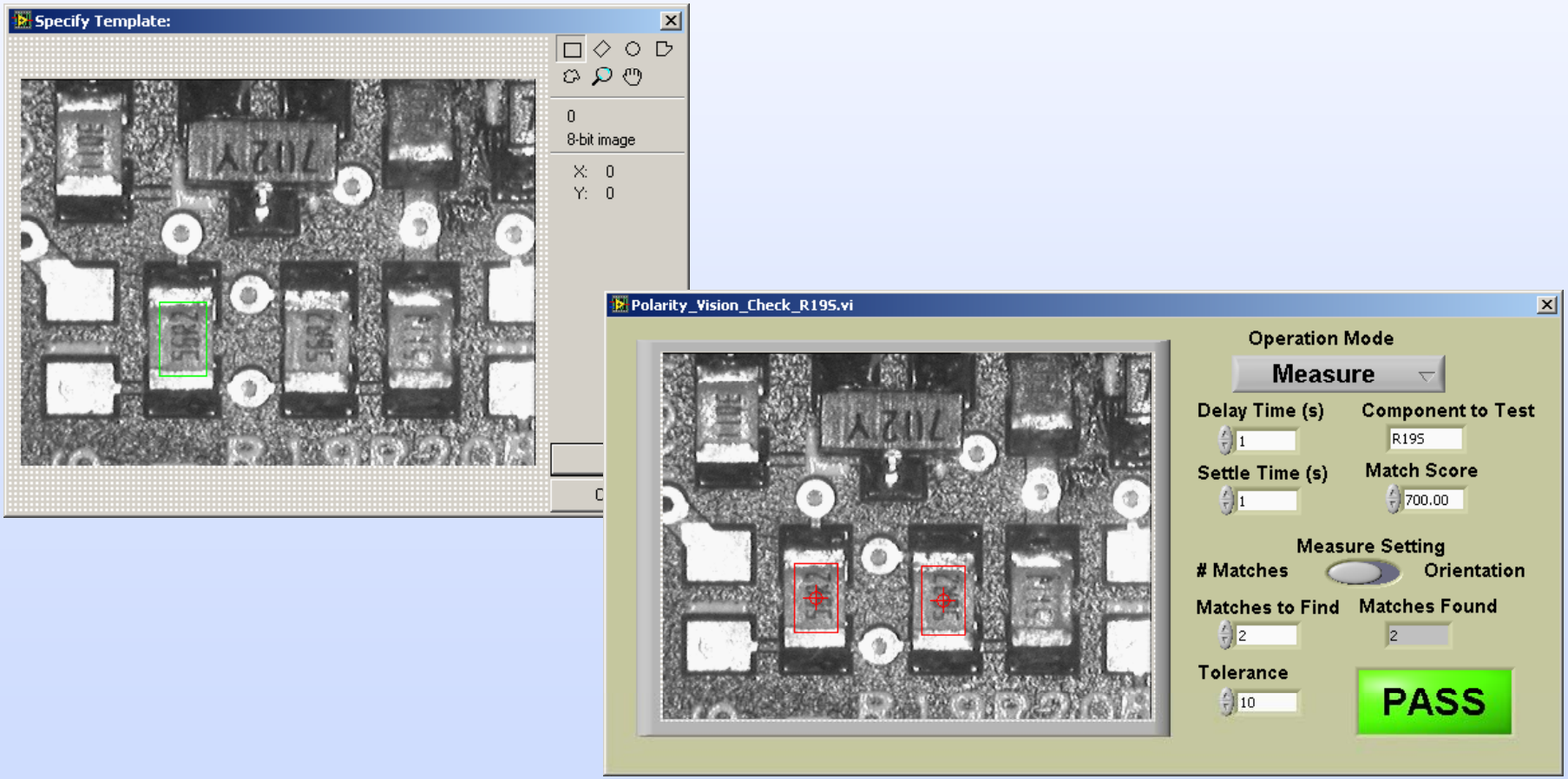
- Nutzt National Instruments „NI Vision“ Bildverarbeitungspaket
- Integration der Vision-Tests in NI TestStand
- Bauteil-Präsenzerkennung
- Bildmustererkennung
- Verpolungserkennung
- Texterkennung



Active Vision
Bauteil-Präsenzerkennung



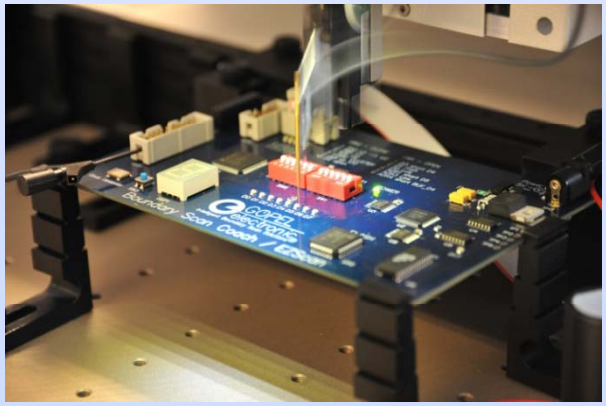
Active Vision Mustererkennung



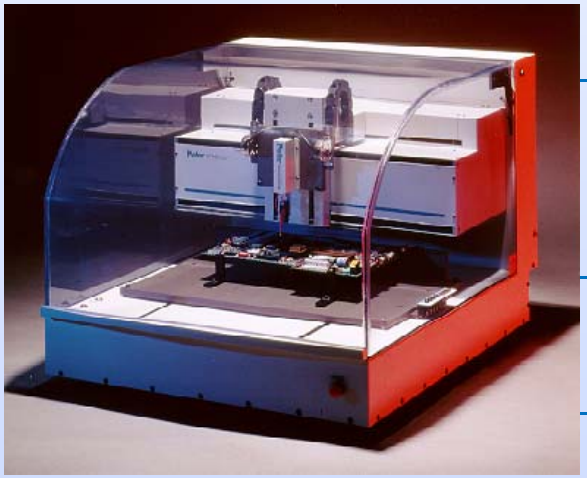
Active Vision Texterkennung

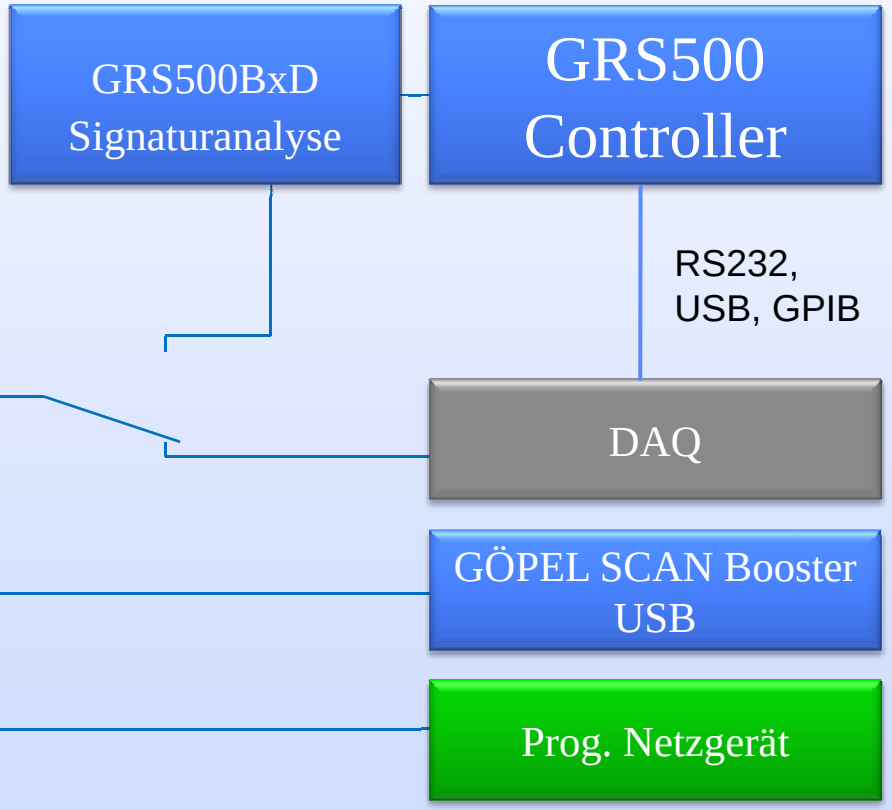
Boundary Scan
Zusatzmodul zu Active Test

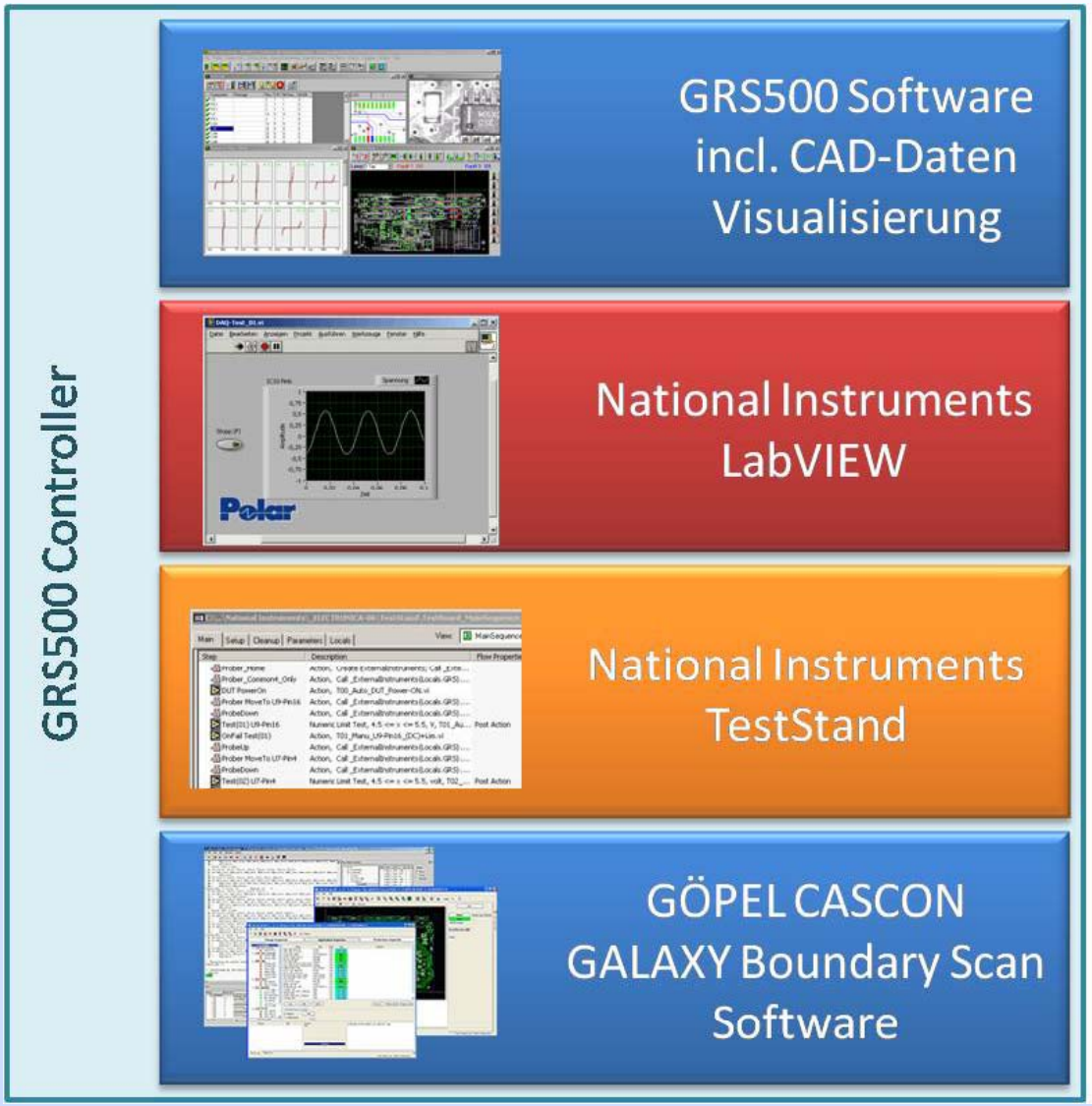
- Einbindung von GÖPEL Boundary Scan Hard- und Software
- Integration der Boundary Scan Tests in NI TestStand
- Überprüfung von Logikpegeln über GRS500
- Kombination mit Active Vision



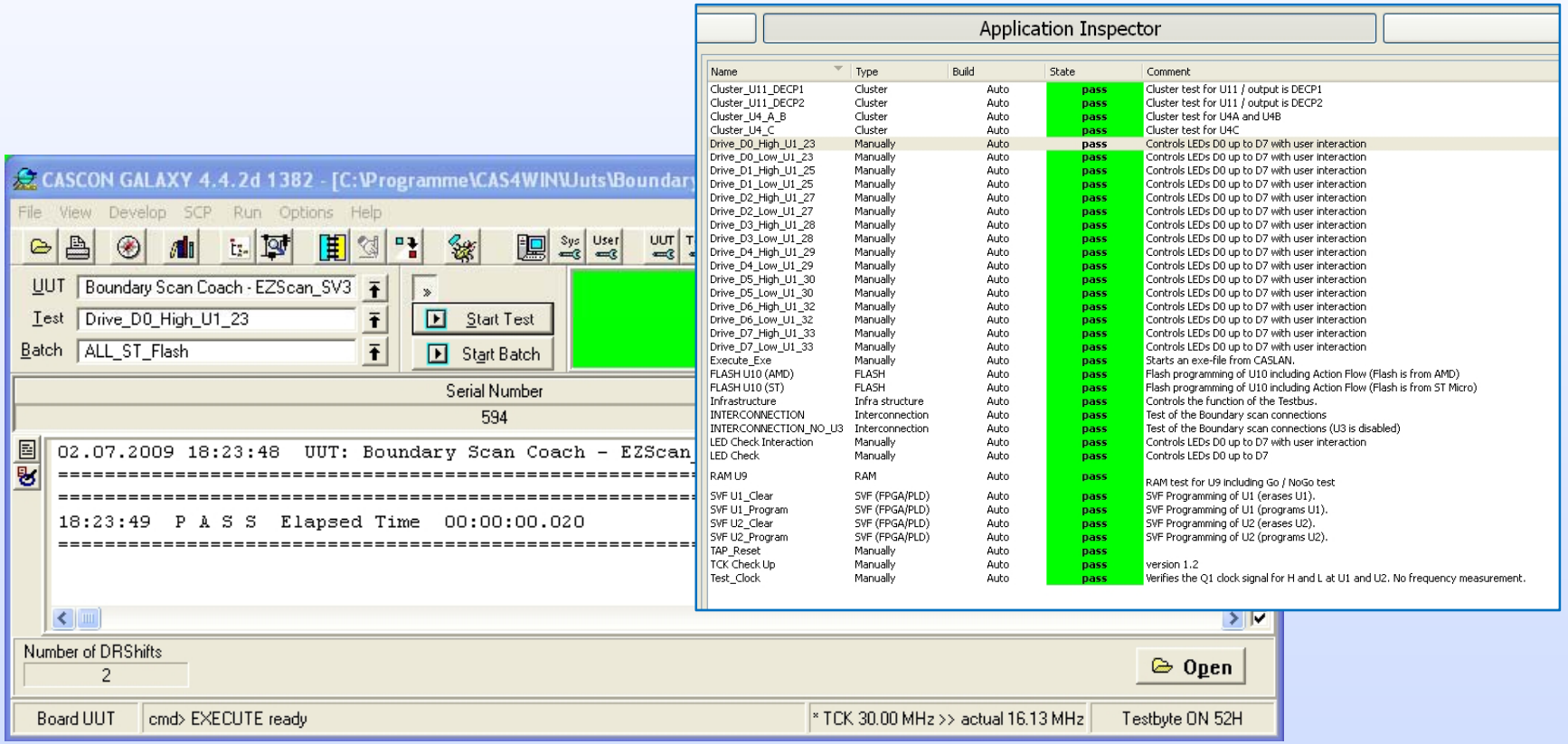
Boundary Scan Test






GRS500 Controller
GRS500 Software
incl. CAD-Daten
Visualisierung
National Instruments
LabVIEW
National Instruments
TestStand
GÖPEL CASCON
GALAXY Boundary Scan
Software

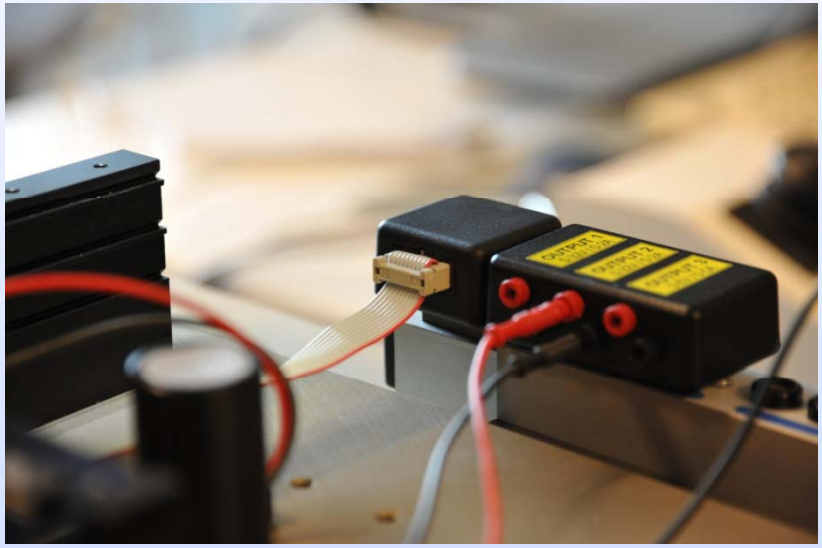
Boundary Scan Test

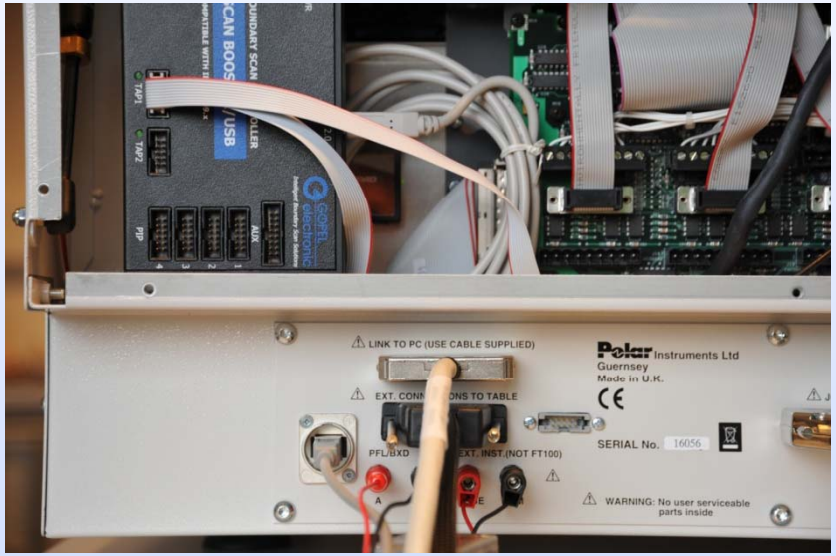


Name	Type	Build	State	Comment
Cluster_U11_DECP1	Cluster	Auto	pass	Cluster test for U11 / output is DECP1
Cluster_U11_DECP2	Cluster	Auto	pass	Cluster test for U11 / output is DECP2
Cluster_U4_A_B	Cluster	Auto	pass	Cluster test for U4A and U4B
Cluster_U4_C	Cluster	Auto	pass	Cluster test for U4C
Drive_D0_High_U1_23	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D0_Low_U1_23	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D1_High_U1_25	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D1_Low_U1_25	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D2_High_U1_27	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D2_Low_U1_27	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D3_High_U1_28	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D3_Low_U1_28	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D4_High_U1_29	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D4_Low_U1_29	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D5_High_U1_30	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D5_Low_U1_30	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D6_High_U1_32	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D6_Low_U1_32	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D7_High_U1_33	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Drive_D7_Low_U1_33	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
Execute_Exe	Manually	Auto	pass	Starts an exe-file from CASLAN.
FLASH U10 (AMD)	FLASH	Auto	pass	Flash programming of U10 including Action Flow (Flash is from AMD)
FLASH U10 (ST)	FLASH	Auto	pass	Flash programming of U10 including Action Flow (Flash is from ST Micro)
Infrastructure	Infra structure	Auto	pass	Controls the function of the Testbus.
INTERCONNECTION	Interconnection	Auto	pass	Test of the Boundary scan connections
INTERCONNECTION_NO_U3	Interconnection	Auto	pass	Test of the Boundary scan connections (U3 is disabled)
LED Check Interaction	Manually	Auto	pass	Controls LEDs D0 up to D7 with user interaction
LED Check	Manually	Auto	pass	Controls LEDs D0 up to D7
RAM U9	RAM	Auto	pass	RAM test for U9 including Go / NoGo test
SVF U1_Clear	SVF (FPGA/PLD)	Auto	pass	SVF Programming of U1 (erases U1).
SVF U1_Program	SVF (FPGA/PLD)	Auto	pass	SVF Programming of U1 (programs U1).
SVF U2_Clear	SVF (FPGA/PLD)	Auto	pass	SVF Programming of U2 (erases U2).
SVF U2_Program	SVF (FPGA/PLD)	Auto	pass	SVF Programming of U2 (programs U2).
TAP_Reset	Manually	Auto	pass	
TCK Check Up	Manually	Auto	pass	version 1.2
Test_Clock	Manually	Auto	pass	Verifies the Q1 clock signal for H and L at U1 and U2. No frequency measurement.

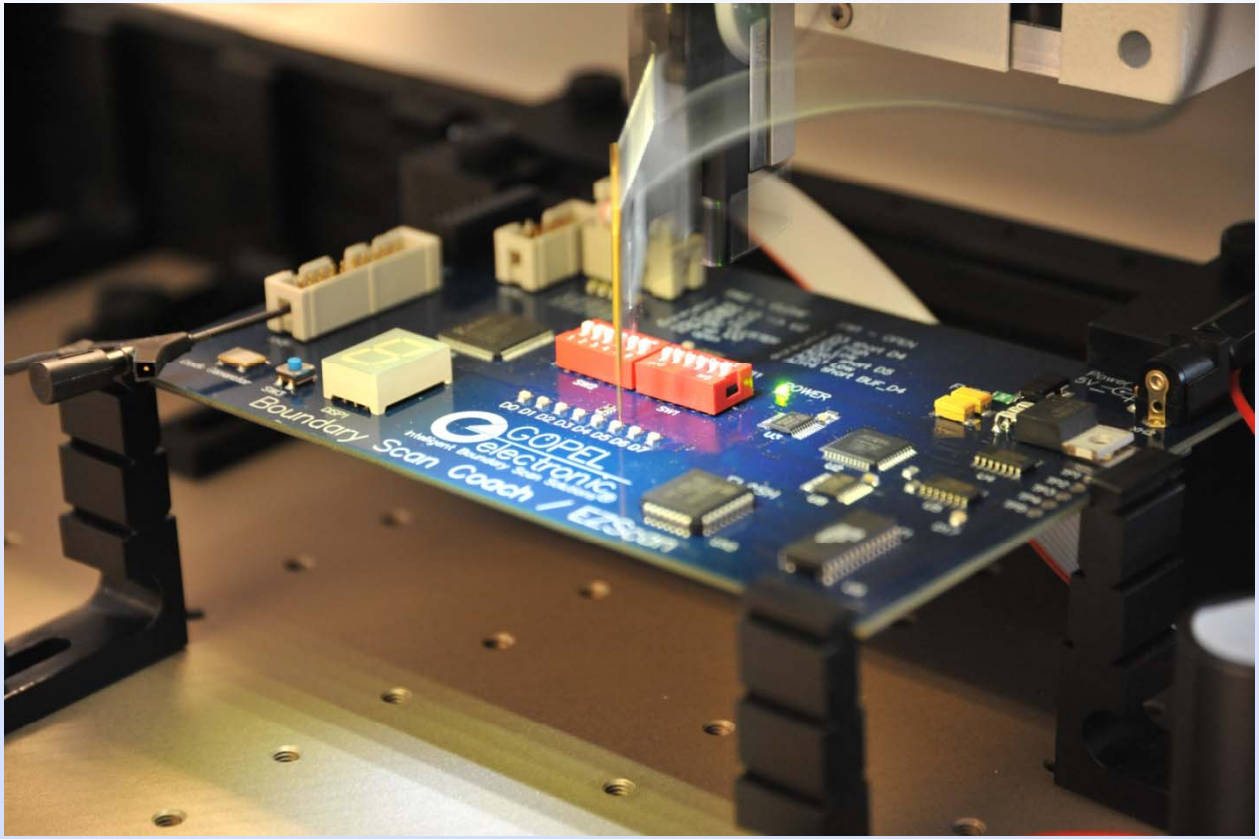
Die Erstellung von Boundary Scan Tests erfolgt in gewohnter Weise über GÖPEL CASCON GALAXY

Boundary Scan Test Integration in GRS500





Boundary Scan Test



Boundary Scan Test in Kombination mit Logikpegelmessungen über den GRS500


GRS500
Repair Test System