REEDHOLM

DATA SHEET

DS-10041

DC Parametric Analyzer Model RI-70

- **Up to 600 Device Pins**
- **Kelvin Sensing to Probe Pins**
- **Full Screen Graphical Editor**
- **Variable Integration Time**
- **Network Ready**
- **Data Driven Test Plans**
- **Automatic Prober Control**
- **Data Acquisition**
- **Windows Option**

Delivering precision measurements at production speeds, the RI-70 dc parametric test system can be expanded from a basic set of 96 device pins to 600 (when 24 optional PAM pins are added to base 576 CPM pins). The non-programming test environment used by hundreds of customers is a standard feature. With few exceptions, parametric test applications served by the RI-40, RI-75, and RI-EG systems can be run on the RI-70 without modification.

Accurate and Fast Timing Control

The RI-70 controller is an industrial ISA computer using a real-time operating system containing an interface card that memory maps the instrumentation to the controller OS. Complex commands are transmitted at speeds much faster than achieved, with instrument buses such as the standard IEEE-488 parallel and serial ones. For instance, control is transmitted from control programs in the CPU to instrumentation in <2µsec.

Compared to slower UNIX® and other multi-tasking OS-based alternatives, the RI-70 has profound performance advantages in the areas of speed, low current measurements and ease of use. Leading semiconductor companies are finding these advantages justify a change from the old standard for next generation process development and control verification.

The system can be used with only the test controller, which can be networked via Ethernet. The system is typically delivered with a Windows PC for user input and instructing the test controller.

System Architecture

Standard configurations of Reedholm parametric test systems provide dc parametric testing to ±200V and ±550mA, plus 100KHz capacitance measurements. The self-calibration module simplifies dc calibration and conformance to quality assurance programs such as ISO9000 and subsequent versions.

In addition, IEEE-488 controlled instruments can be integrated to the system's switching matrix through high quality user function interface modules. The matrix is limited to 2A and 600V.

Switch Matrix Organization

System instrumentation (precision current/voltage forcing supplies and current/voltage meters) are connected through guarded analog pathways, with force and sense lines separated so that voltage can be accurately measured or sensed, no matter how far away the device under test is located.

Switch Protection

Hazard detection software prevents switching relays under conditions that lead to early wear-out of relay contacts. This prevention of "hot" switching results in extremely long relay lifetimes such that mean time to failure of the RI-70 is not significantly different than lower pin count parametric testers sold by Reedholm.

Maximizing Performance

To prevent unacceptable loading on system instrumentation, the switching system is organized into banks that contain 48 matrix pins each. A standard RI-70 has two banks, or 96 pins, in an 86” cabinet. The picture shown in Figure 1 includes the RDS Intranet Lab Edition configuration.

Up to three matrix banks are placed in each matrix cage, and up to three additional matrix cages can be added to the RI-70 cabinet. Fully configured, the RI-70 contains 600 pins.

Customization

Reedholm excels in customization, whether its custom test routines, reports, new instruments, or entire systems. And the RI-70 is the poster child of that customization. The entire system was first developed over 20 years ago in order to perform characterization work on microprocessors plugged into a connected motherboard. That system is still in use today.

Since then the system has been altered and delivered for solar panel characterization along with production CCD testing. Contact Reedholm today in order to see what test needs we can tackle together.

CCD Test System

Figure 2 is the custom CCD test system delivered, along with a DUT box for testing packaged CCDs. The system is also delivered with cabling and software to control an automated prober.

As described in presentation PR0008, CCD Test Library, a GPIB controlled 2A/50V power supply was added for higher current amplifiers. In addition, an entire CCD test library was written that makes it easy to quickly create test plans for massive pin-to-pin testing and reporting.

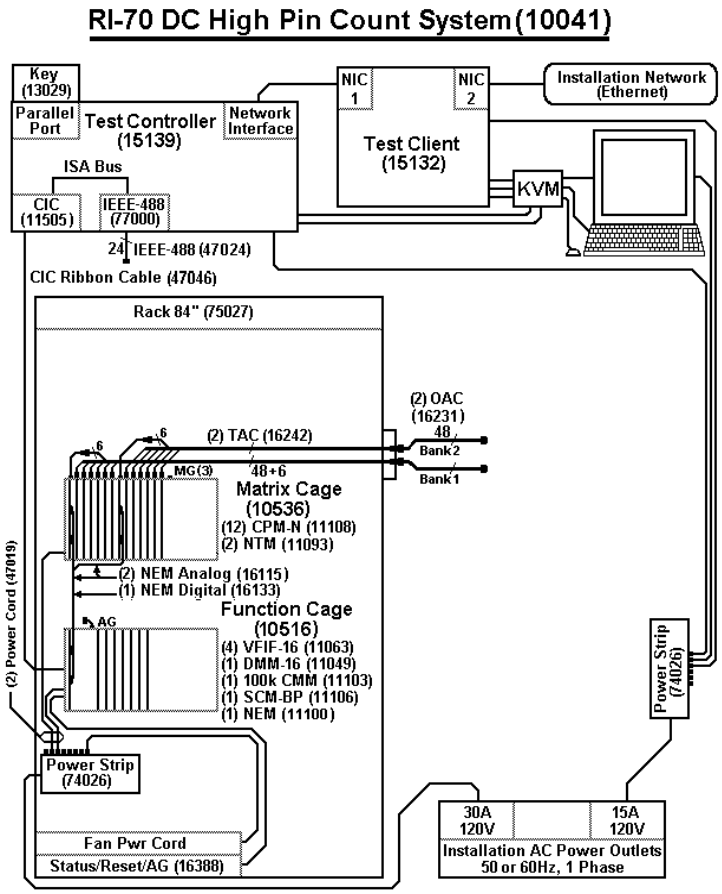

Figure 2 - Basic RI-70 System Deliverables

Figure 2 - 336 Pin RI-70 w/Test Head

RDS Intranet Software

Windows-based RDS Intranet provides a complete solution for automated dc parametric test. The major difference is that the Intranet application runs as an intranet website for the entire facility. As a result, duplicate copies of test plans are no longer an issue. Everything is stored in a single database hosted on Microsoft SQL Server. Also, when the RDS Intranet application was written, numerous changes and enhancements were made to the older DOS version:

- EMPAC and EMAGE were merged into Build, an integrated test plan editor.
- Acquire was simplified to only provide automated testing. Probe pattern creation was moved to Build.
- Acquire, GrafPAC, and EMAGE reports/plots were moved into one application: Examine.
- Support added for more languages: Pascal for the test controller and Visual Basic, C++, etc. for the Windows computers.
- Lot data reports were written using MS SQL Reporting Services so that customers could change and expand reports as desired.
- The IE browser was used for the RDS Intranet GUI so that the latest interface technology (mouse, hyperlinks, multiple windows and frames, etc.) would be inherently available.

Migrating to Intranet from RDS DOS

To facilitate upgrading to the Intranet version, RDS DOS test plans, probe patterns, devices, and test data can be imported. Thus, previous investments in Reedholm software are not lost.

Database-Driven Testing and Probing

Reedholm testing remains data-driven under the Intranet code with data stored in an SQL Server database. Test data is downloaded over an Ethernet connection from the test client to the test controller. Having all tests in a database makes it easier to develop, maintain, and control test plan development.

Build (Test Plan Developer)

In addition to having the combined capabilities of EMPAC and EMAGE, Build has many enhancements:

- Execution of test lists as well as single tests.
- Separate test limits within a process definition.
- Version control/locking of test plans and limits.
- Up to twelve pins per device leg.
- More bias options for each device leg.
- Graphical editing of die and intradie patterns.

For example, Build provides the ability to change test types without having to re-enter pin and bias information. As shown in Figure 7, the test can be changed from "Beta at an I_c" to "Beta at an I_e" to "Beta at an I_b" with single mouse clicks.

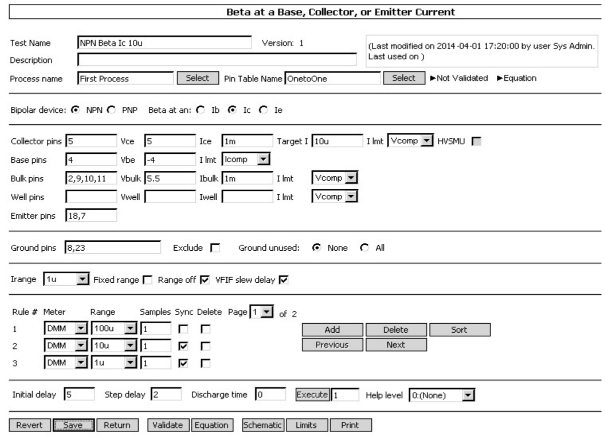

Figure 7 – Build Beta Test Input Screen

Acquire (Production Test Environment)

Acquire was simplified in RDS Intranet to handle only automated testing. Probe pattern and report configuration editing were moved to Build and Examine respectively. New Acquire features include:

- Display of test results without pausing.
- Validation of probing patterns and test plans, required before lot testing begins.
- Devices and/or lots to be tested must match a user input list or one loaded from the network.
- A separate interface for packaged parts.

Automatic Prober Integration

One IEEE-488 controlled automatic prober can be controlled from the RI-70 software. Confirmation of prober control is done at Reedholm's factory. Depending upon the prober, features include:

- Coordinate or wafer map movement.
- Automatic intradie (module) movement.
- Control of multiple inkers with delayed inking.
- Off-line inking.
- Error detection and recovery.
- Input of wafer list for batch mode operation.
- Support of OCR and barcode readers.
- Skip site on failure.

Maintenance Software

The systems are delivered with a variety of self-test utilities and troubleshooting tools:

- Main Diagnostics – comprehensive self-tests.
- Self-calibration – traceability/correction factors.
- Manual Calibrations – other instrumentation.
- Hookup – analog troubleshooting.
- Address Test – digital troubleshooting.

Training

User training is included in the purchase price. Maintenance training is also available for those who maintain the systems.

System Configuration

Instrumentation Cabinet

31" wide, 36" deep, and 86" tall
(787mm x 941mm x 1575mm)

Test Computer and Printer

The actual models are dependent on availability and compatibility with Reedholm software.

Matrix Cage

(12) CPM-N, Crosspoint Matrix Module
(2) OAC, Oven Analog Cable (48 pins)
(2) TAC, Tester Analog Cable (48 pins)
(2) NTM, Node Terminator Module

Instrumentation

(4) VFIF-16, Voltage/Current Forcing Module
(1) DMM-16, Digital Multimeter Module
(1) SCM-BP, Self Calibration Module
(1) 100kHz CMM, Capacitance Meter
(1) NEM, Node Extender Module

Maintenance Fixtures

(1) Loopback Plug for TAC Checkout
(1) Loopback Receptacle for OAC Checkout

Standard Software

MS-DOS V6.2 or Later Operating System
Borland Pascal w/Objects™ V7.0
Reedholm Pascal Instrument Drivers
Reedholm Test Environments
- EMPAC, Acquire, and EMAGE

Reedholm Graphics Analysis: GrafPAC
Reedholm Maintenance Utilities

Options

Matrix Cage Expansions

Up to three additional cages can be added for a maximum of four matrix cages in one cabinet.

Matrix Bank Additions

Up to ten additional banks of 48 pins can be added.

IEEE-488 Controlled Equipment

Generally, any IEEE-488 controlled instrument can be integrated into the RI-70. Check with factory for detailed descriptions and specifications.

User Function Module

A UFM is needed to connect non-Reedholm equipment to the switching system.

Windows Intranet Software

The applications software gets data from and puts data into a central MS SQL database.

Automated DC Calibration

The SCM has an accurate, stable voltage reference, coupled with an instrument grade high voltage amplifier. This provides precision currents and voltages for all of the dc instruments. In operation, the SCM is used to generate offset and gain error correction factors for dc instruments, after which the factors are used to prevent source errors and to compensate for measurement errors. As long as the self-calibration software can correct module accuracy, the module meets its accuracy specifications.

SCM Transfer Accuracy (24 Hr, ±2C°)			
Voltage Range (V)	Error (% of Value)	Current Range (A)	Error (% of Value)
0.25	0.05	100n	0.04
0.50	0.03	1µ	0.02
1.00	0.02	10µ	0.02
2.50	0.01	100µ	0.02
5.00	0.01	1m	0.02
10.0	0.01	10m	0.02
25.0	0.01	100m	N/A
50.0	0.01	1	N/A
100	0.01		

Specifications

Instrument hardware specifications apply at the end of a 3-foot prober analog cable (PAC) without a probe card attached. Some commonly used wafer test accessories (especially probe cards) significantly reduce parametric testing accuracy. Extreme care is taken in designing the test environment to achieve maximum performance.

Use Conditions

Temperature: 18°–28°C
Humidity: 10%–50% R.H. Non-Condensing

Nominal Power: 117V, 60Hz

Regulated supplies isolate instrumentation from power line variations of more than ±10%. Voltage and frequency must be specified for other levels.

Switching System

The switching sub-system is a critical element of a dc parametric test station. Reedholm has taken special care to develop low noise, high-performance matrix switching modules. These specifications apply to the user function interface module, as well as the CPM and node switching of the function modules.

1) Maximum Stand-off Voltage: ±600V
2) Maximum Carrying Current: ±2A
3) Pin-to-Pin Leakage (guarded at ±100V): <±10pA
4) Pin-to-Pin Leakage (unguarded at ±100V): <±1nA
5) Pin-to-Pin Thermal EMF: <±10mV
6) Pin-to-Pin Resistance (shorted): <500mW
7) Switching Speed (including software delay): 1ms

Voltage/Current Forcing (VFIF-16) Module

Mode	Range	Source Error		Resolution
		Offset	% of Value	
Voltage	2.5V	250µV	0.014	78.125µV
	5V	500µ		156.25µV
	10V	1mV		312.5µV
	25V	2.5mV		781.25µ
	50V	5mV		1.5625mV
	100V	1-mV		3.125mV
Current	100nA	125pA	0.04	1.5625pA
	10µA	125pA	0.02	15.625pA
	1µA	500pA		156.25pA
	100µA	5nA		1.5625nA
	1mA	50nA		15.625nA
	10mA	500nA		156.25nA
	100mA	5µ	0.04	1.5625µA
	1A	50µA	0.05	15.625µA

1) Range offset errors apply for a 24-hour period after SelfCal and for temperature changes <±1 degree C.
2) Gain factor (% of value) errors apply after running SelfCal with an ideal (<±10ppm uncertainty) transfer DMM. Actual performance is calculated using Support Note SN-115.
3) Current specifications apply up to 200mA. Active limiting begins at approximately ±203mA.
4) Current mode CMRR: <0.0002% of range/volt output.
5) Accuracy on the lowest two current ranges is measured with line cycle integration.
6) Current accuracy on a given range has uncertainty of ± (offset error + % of value error). For example, forcing 100µA on the 100µA range results in:
   - I_{out} = 100µA ± (5nA + 0.02% of 100µA)
   - I_{out} = 100µA ± 25nA
7) Voltage accuracy uncertainty is ± (offset error + % of value error). For example, forcing 1V on the 2.5V range results in:
   - V_{out} = 1V ± (250µV + 0.014% of 1V)
   - V_{out} = 1V ± 390µV

Capacitance Meas. (100kHz CMM) Module

Range (pF)	Source Error		Resolution (fF)
	Offset	% of Value	
100	0.01% of Range	0.1	3.125
1000		0.1	31.25
10000		0.1	312.5

1) Repeatability is within ±10fF for stable conditions.
2) Maximum capacitance is 10nF.
3) DC voltage biasing does not affect accuracy.
4) Range errors shown with offset compensation, which increase to 4pF without offset compensation.
5) % of Value errors are based on a 48" TAC/PAC and auto-calibration. Without auto-calibration, accuracy is not guaranteed.
6) Accuracy of the capacitance measured is proportional to the range offset error and a percentage of value measured. For example, measuring 50pF on the 100pF range:
   - Cx = 50pF ± (0.25pF + 1% of 50pF
   - Cx = 50pF ± 0.75pF
   - Test Frequency: 100kHz ± 0.01%
   - Test Levels: Selectable, 15mV/100mV rms ± 1.0%

Digital Multimeter (DMM-16) Module

Mode	Range	Measure Error		Resolution
		Offset	% of Value	
Voltage	250mV	250µV (50µV)	0.05	7.8125µV
	500mV	250µV (50µV)	0.03	15.625µV
	1V	300µV (75µV)	0.02	31.25µV
	2.5V	500µV (100µV)	0.01	78.125µV
	5V	1mV (200µV)		156.25µV
	10V	2mV (400µV)		312.5µV
	25V	5mV (1mV)		781.25µV
	50V	10mV (2mV)		1.5625mV
	100V	20mV (4mV)		3.125mV
Current	100nA	100pA	0.04	3.125pA
	1mA	300pA	0.15	31.25pA
	10mA	2nA*	0.02	312.5pA
	100mA	20nA		3.125nA
	1mA	200nA		31.25nA
	10mA	2mA		312.5nA
	100mA	20mA	0.04	3.125µA
	1A	200mA	0.05	31.25µA

1) Range offset errors apply for a 24-hour period after
2) Maximum output current on 1A range is 200mA. On other ranges, the maximum is 125% of range.
3) Settling time to 0.01% 4.0ms, 100nA Range
4) 2.3ms, 1mA Range
5) 1.7ms, 10mA-1A Ranges
6) 1.6ms, 250mV-100V Ranges
7) CMRR Voltage: <5uV/V (106db)
   CMMR Current: <1ppm of range per volt, 10mA-1A
8) <2ppm of range per volt, 1mA
9) <6ppm of range per volt, 100nA
10) Accuracy on the lowest two current ranges is measured with line cycle integration.
11) Accuracy of current measured on a given range is proportional to range error and a percentage of current being measured. For example, measuring 50mA on the 100mA range would have uncertainly of:
    - 50mA ± (20nA + 0.05% of 50mA) = 50mA ± 45nA
12) Range Error shown in parentheses () applies for an 8-hour period after auto zero, and for ±1C°.
13) When measuring current from sources with non-zero output conductance, add the following amounts to the error specification:
    - ±(830ppm of value + 151pA)/mho

Support

Warranty

Each system comes with a 12–month factory warranty for defective parts and labor. Additionally, extended warranty and service contracts are available.

User Training

Training on the use of diagnostic and applications programs can occur at the factory or on site during installation.

Application Support

Technical phone and e-mail support is available from the U.S. Monday through Friday, excluding holidays. Contact us by

- Phone: (512) 876-2268
- Email: support@reedholmsystems.com