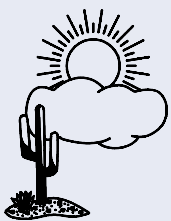


Model 2553 Passive Network Quartz Crystal Test System

- Frequency range from 10KHz to over 300MHz
- Measurements with HP E5100 Network Analyzer
- -65°C to +125°C Temperature Range using CO₂ or LN₂ cooling
- Dual chamber operation optional
- Ruggedized Conformally Coated Pi Network Test Head
- User adjustable C_{load} Capacitor, available in multiple ranges or fixed values
- Rapid testing of tuning fork resonators.



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System Features

- Single or dual chamber operation
- PRA Model 155 performs signal multiplexing (10KHz to 300MHz) and increases drive level ranges (2MHz to 300MHz)
- Uses HP Network Analyzer HP E5100A
- Series and Load resonant testing
- Actual load capacitor or computed load capacitor measurements
- IEC 444 compatible passive network measurements,
- Up to 512 crystals per run (using 4 row test wheels)
- Drive level 1pW to 5mW (2MHz to 300MHz)
- Mixed frequencies, mixed specifications and mixed temperature ranges are possible in a run.
- Power sweep measurements, drive level dependency testing.
- Spurious modes, harmonic frequency, and mode placement testing.
- Full Pass/Fail limit testing, limit analyses performed automatically at the completion of the run.
- High speed measurements limited only by the crystal Q
- Full calibration for each wheel type stored on the system disk.
- Menu driven software.
- Operation with an IBM™ Compatible PC with Windows XP Pro.
- All files are stored in ASCII text form.

Pi Network Test Wheels and Head

The test system can use 1, 2, 3 or 4 row test wheels (The figures show 4 row configurations). The more rows has the advantage of permitting more crystals per test run. The higher number of rows is permitted in the new PRA chambers that feature improved vertical temperature uniformity and have sufficient drive wheel positioning accuracies.

Numerous test wheels types are available to accommodate the large number of crystal package types, including many of the popular SMT packages. The 4 row test wheel for HC45, HC49, UM1 or similar types will hold 512 crystals (4 rows of 128 crystals each).

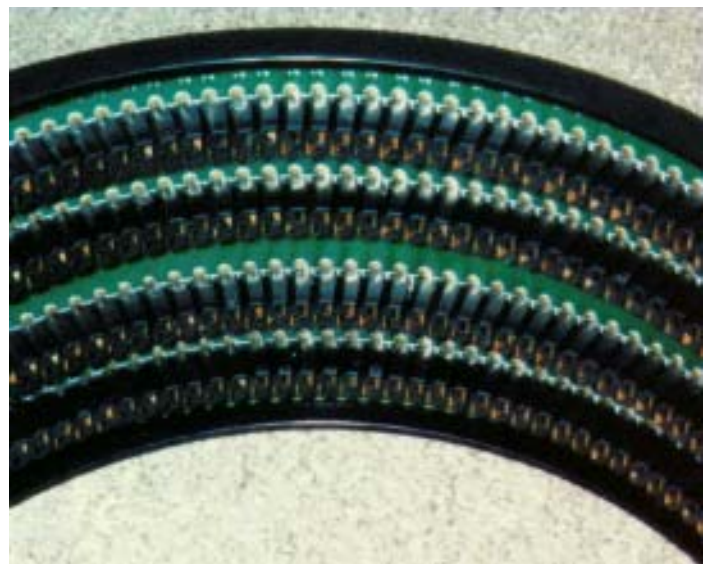
The head features direct cable connections to the PRA Model 155 Network Analyzer Interface to the SMA connectors on the Pi Network Cards. The Pi Network cards in the heads can be reversed to allow the coaxial cables to go to the left or right of the chambers. The cables lay unstressed on the chamber tops permitting long cable life.

The Pi Network Head is constructed from mechanically stable phenolic and a new long chain polymer plastic. The head is mounted on a corrosion free stainless steel plate. The wiper contact pressure has been optimized to reduce wear while maintaining low resistant contacts. The low contact pressure contributes to good test wheel life.

The ruggedized Pi Network Card has multiple configurations. The Card can be purchased in

a Series Resonant, 9 to 21pF or 21 to 34pF range. The Pi Network Card can also be ordered to user requested specific values.

The conformally coated surface mount construction reduces mechanical problems and improves frequency response. The surface mount construction using standard components permits lower card cost. Multiple cards can be purchased, one for each Cload value thus improving measurement repeatability. The cards are easy to change in the head and the wipers automatically align themselves



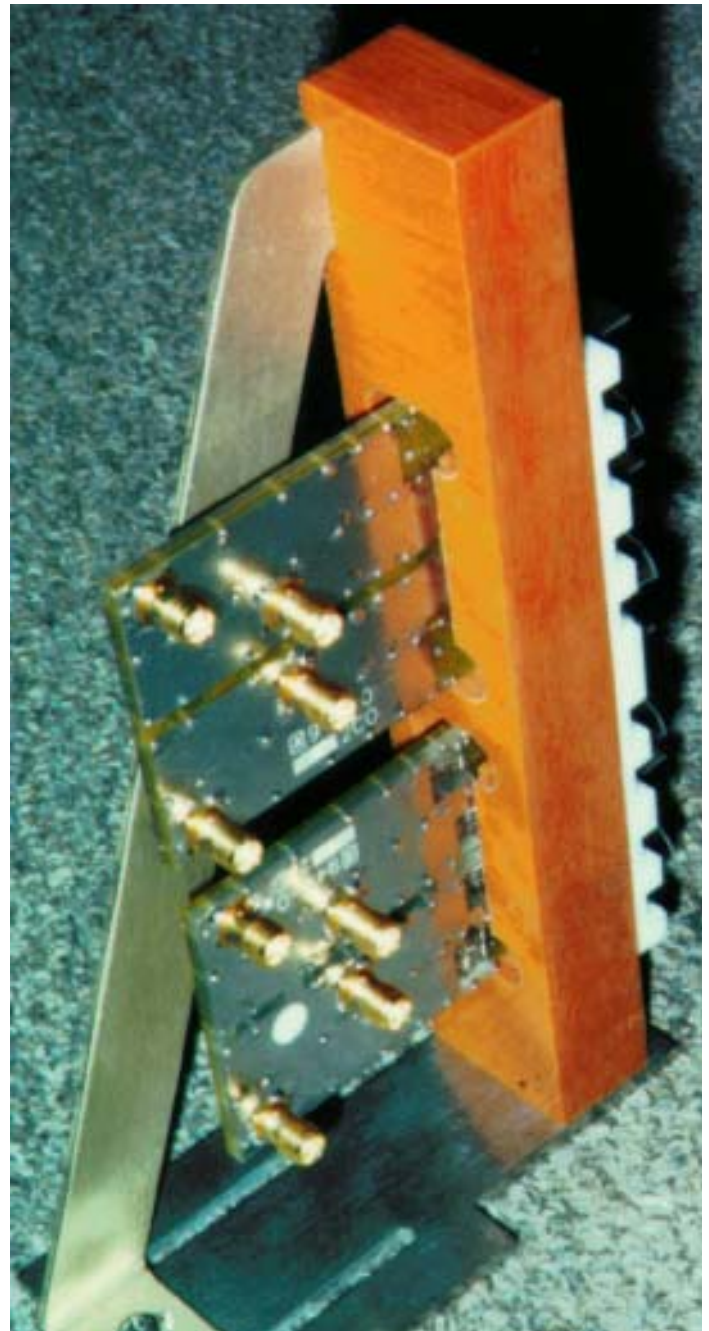
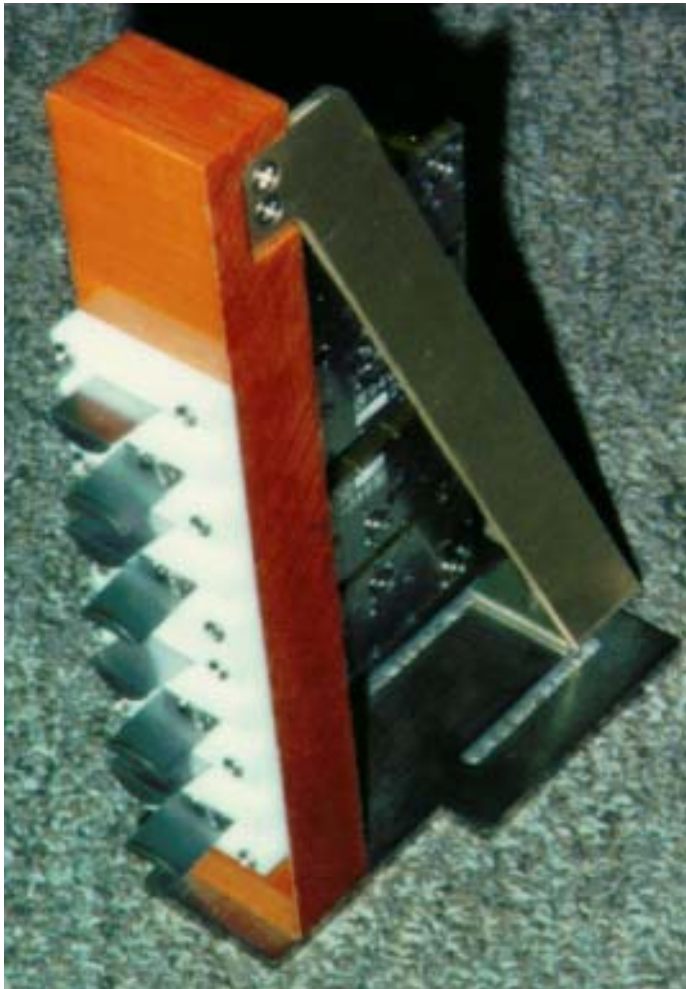
reducing the change over time between runs.

The software permits storing multiple test head and test wheel calibrations further simplifying the use of multiple test heads (this means there is optimum calibration stored for each individual wheel type and head).

To change a test head takes less than 10 minutes. The change requires disconnecting and re-connection 8 each SMA connectors and 4 screws that hold the head in place.

The test heads have a pair of IEC444 compatible Pi Networks in each PCB assembly.

Alternate Pi Network terminations can be used to permit testing low frequency, high Rr crystals.



System Operation

The system programs are menu driven and are designed to prompt the user as much as possible.

The data files are all in ASCII format to permit any language or programs that will operate on a PC. The data is organized so selections can be made by specification name, user entered comment and time of run.

Starting a Test Run:

The test runs can be started by entering the following information that affects all the crystals in the run:

- Type of test head and test wheel (defines calibration)
- Test procedure (defines the temperature chamber test sequence).

For each crystal type in the run:

- Specification name
- Location of the crystals in the test wheels
- User entered comment
- Crystal serial number (optional)

Entering a Specification:

The specification determines the temperature ranges for the actual specification parameters, the limits on the various measurements, and what printouts are desired for crystals with this specification. The limits can be placed on motional parameters, frequency deviations, curve fit parameters, etc.

Entering a Test Procedure:

The test procedure sets the temperature sequence that the chamber will follow. The test procedure is entered with an interactive program and the procedure is stored on disk. Temperature range is only limited by the chambers capability. The number of measurements steps could be as small as 0.1°C.

Printouts:

The crystal data can be printed automatically at the end of the run or the user can select the crystal data stored on disk and print that data at any time.

Motional Parameters The measurement of full crystal parameters and including the computation of Q, C1, trim sensitivity, etc. can be defined.

Deviation Printouts Condensed printouts of the deviation versus a specified frequency or as deviation from a temperature can be printed.

Curve Fitting The data can be fit to a 3rd or 4th order polynomial, the inflection and turning point temperatures and goodness of the fit can all be printed.

Plotting The data can be plotted to the screen or to the printer. The plots can be auto scaled or plotted to user defined scales. The plots can include curve fitted data and the error between the smooth curve and the actual data.

Rank Sorting The crystals can be sorted into ranks. The programs supports several types of rank sorting. The user enter the rank sorting rules and the crystals are then listed by the groups the crystal fits into.

EXCEL The data can be written in a file format that can be read by MicroSoft EXCEL or similar spread-

sheet program.

Data Management:

Data management programs are included. This permits moving data to other disk drives (local or via a LAN). The files can also be deleted or copied to other disks as well.

Calibration:

The calibration programs correct the cable lengths,



and Pi Network strays to permit accurate measurement of crystals. The program prompts the sequence to follow and stores the calibration information to the computer hard disk.

System Checkout:

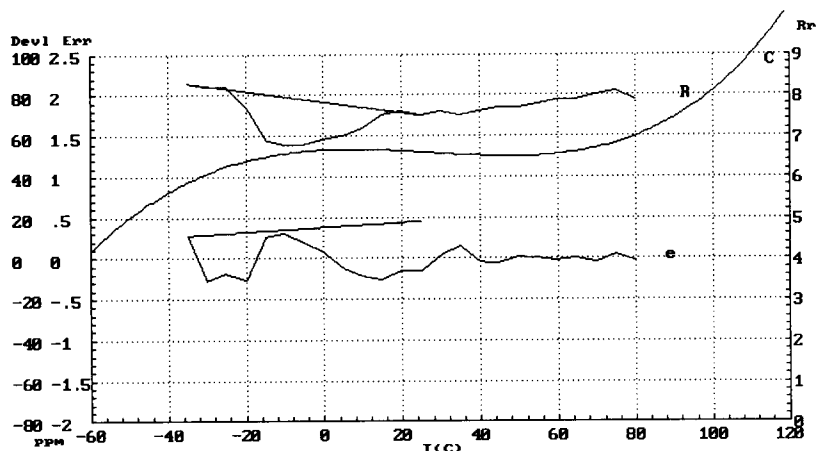
Programs are supplied to permit checking each item of the system for proper operation. This greatly simplifies system maintenance.

```
Device:1- 3 S.N.: 003
Lot: MP35
Spec: SPECI\ 1.SPC 06-21-1996 17:42:02
Nominal Frequency:20.0000000MHz
Device Status: Passed

C.F. coef:
 5.30811E+01 9.37717E-02 -7.56305E-03
 8.35033E-05 1.13825E-07

Turn Points (C):
 7.0 48.4

Inflection Points (C):
28.0
```



Example plot showing the fitted curve, the error of the actual data and the Rr readings versus temperature.

System Configuration

The system can be configured as a 1, 2, 3 or 4 row system. A 2 row test wheel can be used in a 2, 3 or 4 row system. A 3 row wheel can be used in a 3 or 4 row system. The number of desired rows must be defined when the system is ordered. A single row system will not require the PRA Model 155, this results in a maximum drive level of typically 500uW.

Qty	Description
1	PRA Model 6200 round chamber with integrated drive ring and cover optional: S&A Model 4220 chamber with component support wheel and 4" chamber cover (only 2 row test heads and wheels allowed with S&A chambers)
1	HP E5100A Network Analyzer
1	PRA Model 155 System Multiplexer (optional) (Without the Model 155 - only 1 row testing is permitted) Includes: power amplifier used to drive crystals from 0.7mW to > 5mW in 2MHz to 300MHz range. Increases E5100 high drive range. Multiplexer operates over 10KHz to 300MHz range Signal attenuators for high drive E5100 input protection. Switching to drive multiple Pi Networks (multi rows, multi heads - 8 positions allowed)
1	PRA Pi Network Head for series resonance testing.
1	PRA Pi Network Head with adjustable glass piston trimmer Cload 9 to 21pF
1	PRA Pi Network Head with adjustable glass piston trimmer Cload 21 to 34pF
2	PRA Equipment Bays, 1 with power distribution box
1	Controlling Computer IBM™ compatible Pentium PC, Windows XP Pro with NI AT-GPIB, Parallel IO expansion card, over 1 GByte hard disk and minimum of 8M RAM.
1	Monitor
1	HP Laserjet printer (optional)
1	Set of PRA cabling (GPIB, coaxial, printer, chamber interface, etc.)
1	PRA System Software (includes source code written in Visual BASIC for DOS)
1	System Manuals (over 225 pages of system operation details)

Add on of a 2nd chamber:

Qty	Description
1	PRA Pi Network Head for series resonance testing.
1	PRA Pi Network Head with adjustable glass piston trimmer Cload 9 to 21pF
1	PRA Pi Network Head with adjustable glass piston trimmer Cload 21 to 34pF
1	PRA Model 6200/6201 round chamber with integrated drive ring and cover
1	Set of add on cabling (coaxial, chamber interface, etc.)

The PRA Model 155 is required.

Test wheels for the desired crystal packages to be tested must be ordered.

Other test head configurations available.

NOTE: PRA Inc. reserves the right to make changes to the product contained in this data sheet in order to improve the design or performance and to supply the best possible product. PRA Inc. reserves the right to make these changes without notice.

Revised 9/22/07