ANAMET REPORT

ANAMET Report 003
November 1996

ANAMET-951
Type-N Measurement Comparison at Lower RF
-> Some additional Results using different ANAs

J Ruefenacht

Comments on this report should be sent to:

ANAMET
PO Box 92
Malvern
United Kingdom
WR14 3YS

This report has been approved by the ANAMET Steering Committee.

ANAMET-951 TYPE-N MEASUREMENT COMPARISON AT LOWER RF -> SOME ADDITIONAL RESULTS USING DIFFERENT ANAs.

Author: Juerg Ruefenacht, Swiss Telecom PTT

Introduction

During 1995, the Swiss Telecom PTT decided to carry out some additional investigative measurements during participation in the ANAMET-951 exercise. The investigation would enable system-to-system variations in the Swiss Telecom PTT systems to be examined and compared with the ANAMET consensus value produced by the ANAMET comparison exercise.

The ANAMET-951 comparison exercise involved measuring the reflection coefficient of six line terminations fitted with Type N, 50Ω, coaxial connectors. There were three male and three female line terminations with nominal VSWRs of 1.05, 1.20 and 1.50 to be measured. The participants were invited to submit measurements of the reflection coefficient at the following frequencies; 100 kHz, 300 kHz, 1 MHz, 3 MHz, 10 MHz, 100 MHz and in steps of 100 MHz to 1 GHz.

Measuring systems

The following network analyser systems and setups were used to make the Swiss Telecom PTT internal comparison measurements:

A HP8753D with option 1D5 (High stability frequency reference) with an integrated S-parameter test set. The calibration kit was a HP85032B with selected loads, which have a good return loss up to 6GHz. The "S11 one port" calibration was performed using the internal Open-Short-Load calibration routine over the frequency range 30kHz to 1000MHz.

Main analyser settings:			
	Test Port power	: 0dBm	
	IF BW	: 10Hz	
	SWEEP TIME	: 20s	(by measuring a frequency list with 125 points)
	AVERAGING	: 16	

-> These measurement results were published in the ANAMET-951 final results report.

A HP8510C using the HP8515A S-parameter test set and a HP85054B calibration kit. The "S11 one port" calibration was performed using the internal Open-Short-Load calibration routine over the frequency range 50MHz to 1000MHz.

Main analyser settings:			
	Power Source 1	: 10dBm	
	SWEEP TIME	: Not selectable	(set by measuring a frequency list with 95 points)
	AVERAGING	: 512	

A HP3577A using the HP35677A S-parameter test set and a HP35678A calibration kit. The "S11 one port" calibration was performed using the internal Open-Short-Load calibration routine. The measurements where divided in two frequency ranges: 100kHz to 10.1MHz and 10MHz to 200MHz.

Main analyser settings:			
	AMPTD	: 15dBm	
	RES BW	: 1Hz	
	SWEEP TIME	: 30s	(by measuring 51 frequency points)
	AVG	: NO	

A HP8751A network analyser with option 001 (High stability frequency reference) using a HP87511A S-parameter test set and a HP85032 calibration kit with selected loads. The "S11 one port" calibration was performed using the internal Open-Short-Load calibration routine over the frequency range 30kHz to 500MHz.

Main analyser settings:			
	Test Port power	: 0dBm	
	IF BW	: 2Hz	
	SWEEP TIME	: 55s	(by measuring a frequency list with 75 points)
	AVERAGING	: NO	

A HP8751A network analyser with option 001 (High stability frequency reference) using a HP87512A Transmission / Reflection test set and a HP85032 calibration kit with selected loads. The "S11 one port" calibration was performed using the internal Open-Short-Load calibration routine over the frequency range 30kHz to 500MHz.

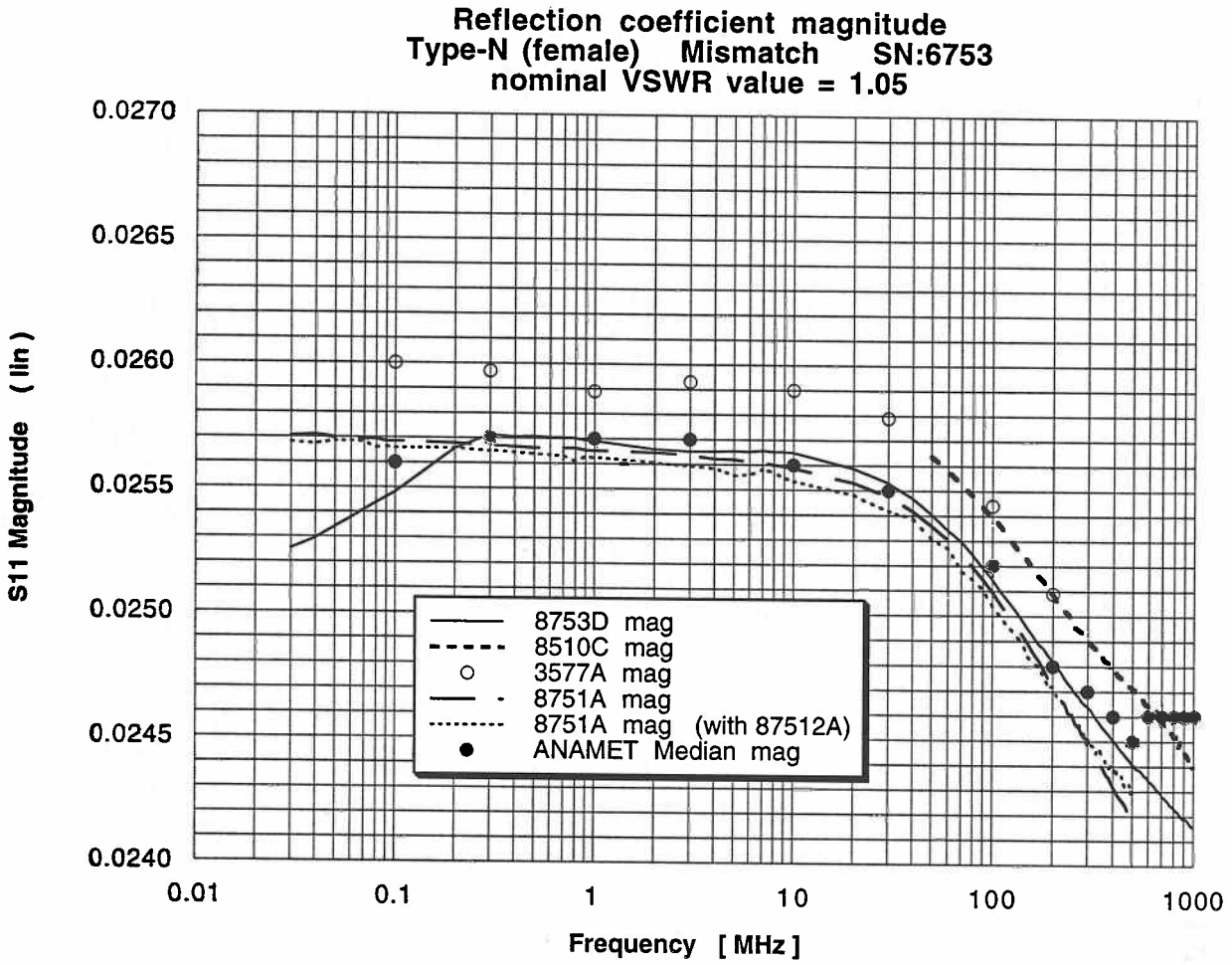
Main analyser settings:			
	Test Port power	: 0dBm	
	IF BW	: 2Hz	
	SWEEP TIME	: 55s	(by measuring a frequency list with 75 points)
	AVERAGING	: NO	

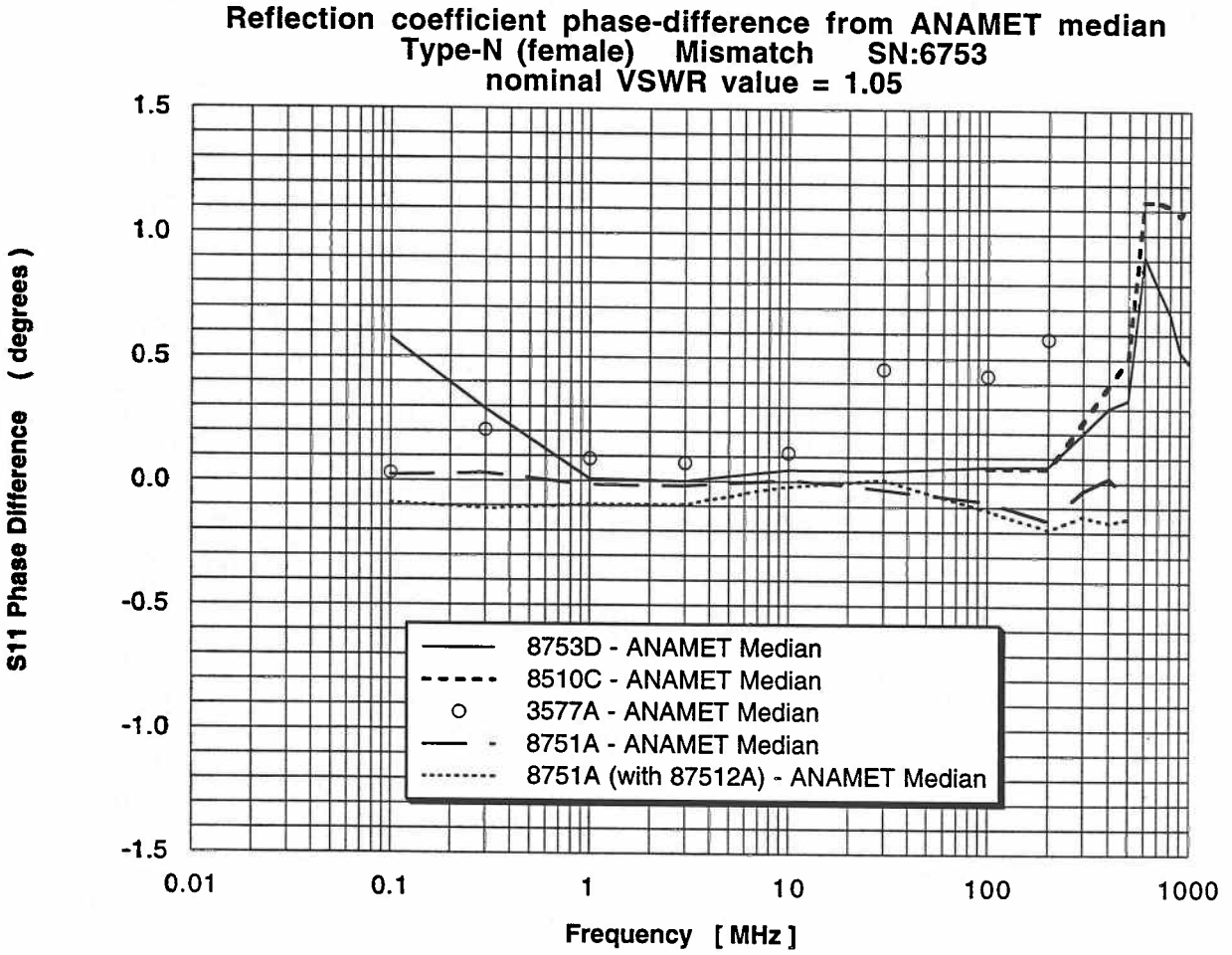
Comparison results

The next six pages show the results of the internal comparisons. Each measured line termination is presented with a magnitude and a phase difference graph. The phase differences are calculated with the ANAMET Median values as reference.

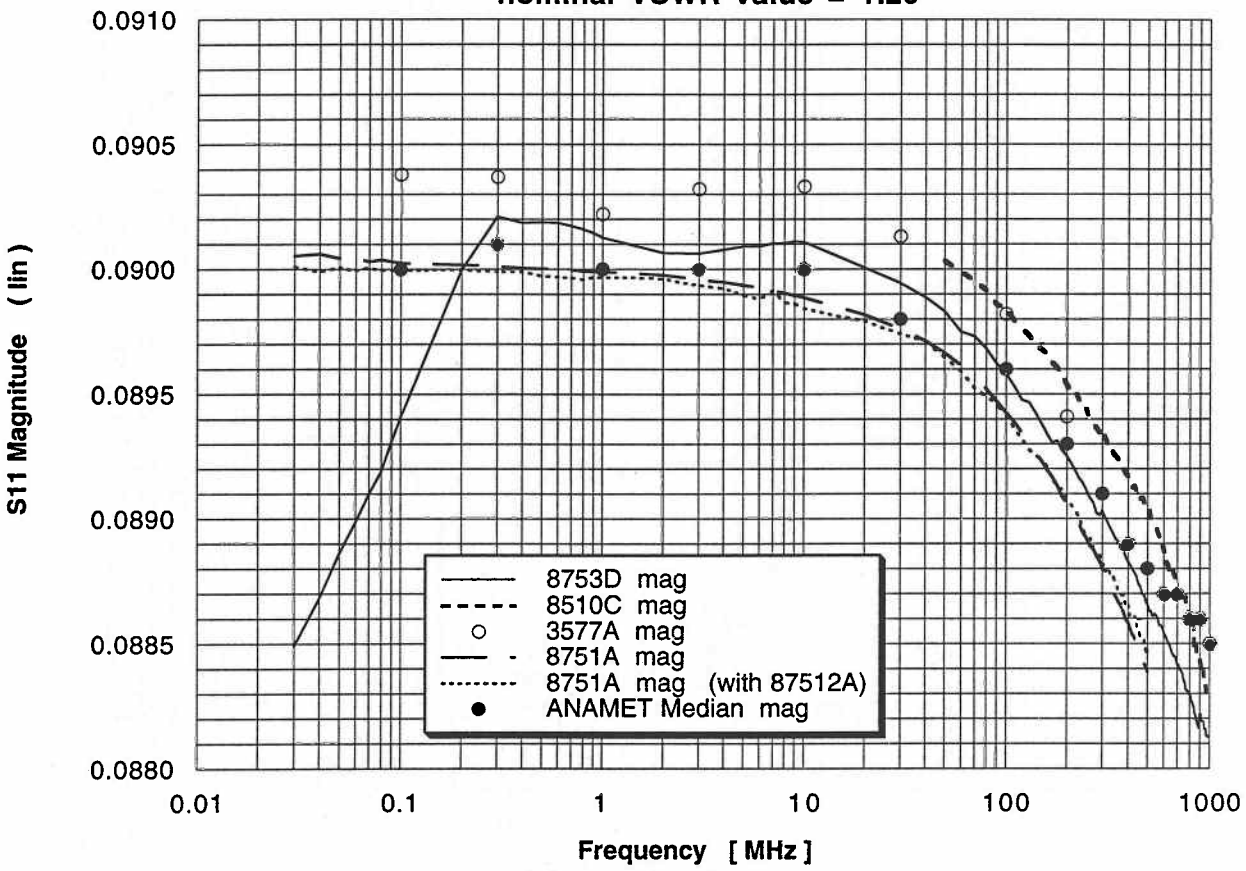
Conclusions

The results show that the four network analyser types (8753D, 8510C, 3577A and 8751A) have a very good agreement between the different measurements.
All analysers are very sensitive to the selected sweep time (with exception of the 8510C, where the sweep time is not selectable). When making precise measurements it is advisable to reduce the IF bandwidth and to set the sweep time at least to 1s .
Another consideration is the quality of the calibration standards. With the help of these additional measurements, significant differences were found to be dependent on the quality of the fixed loads. This consequence will be discussed in a future ANAMET publication.

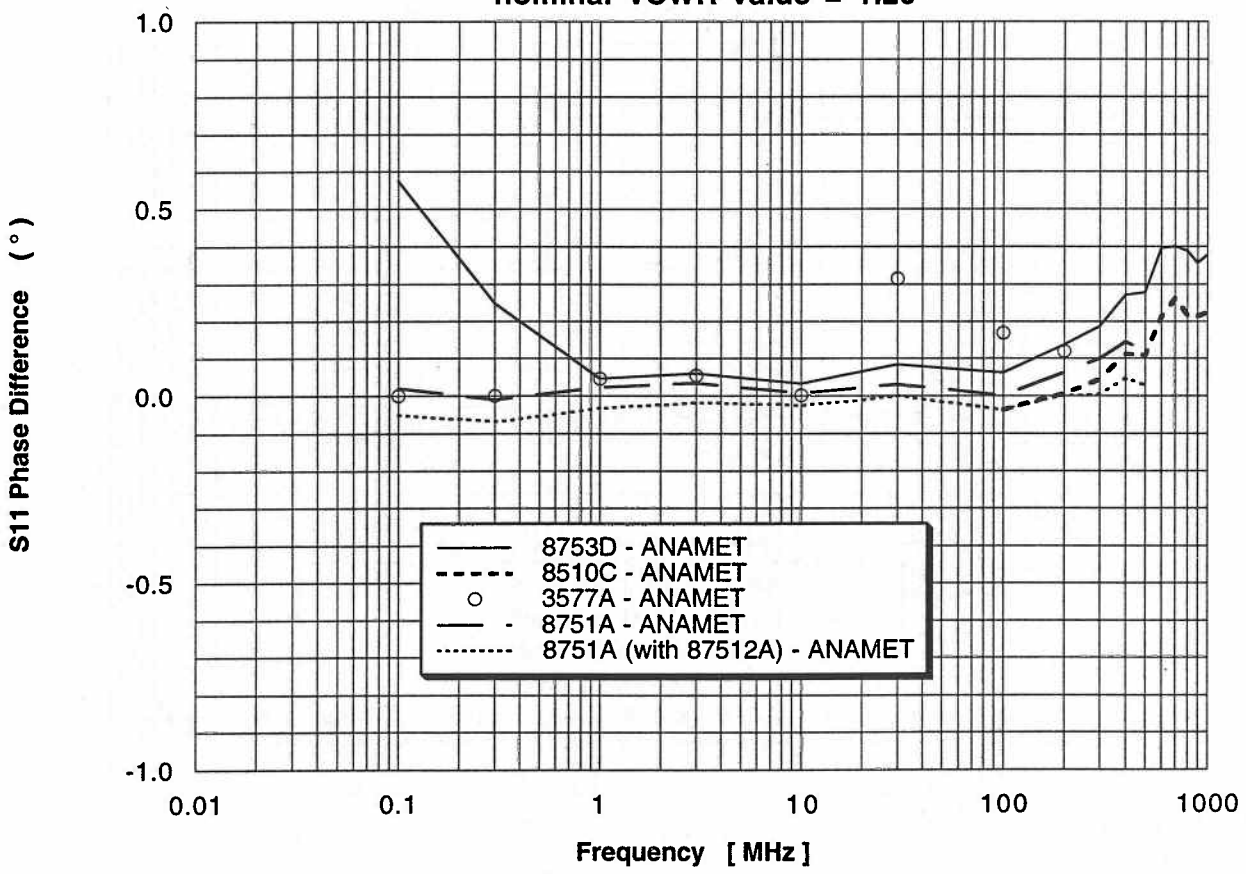

Reflection coefficient magnitude
Type-N (female) Mismatch SN:6753
nominal VSWR value = 1.05
S11 Magnitude (lin)
0.0270
0.0265
0.0260
0.0255
0.0250
0.0245
0.0240
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D mag
8510C mag
3577A mag
8751A mag
8751A mag (with 87512A)
ANAMET Median mag

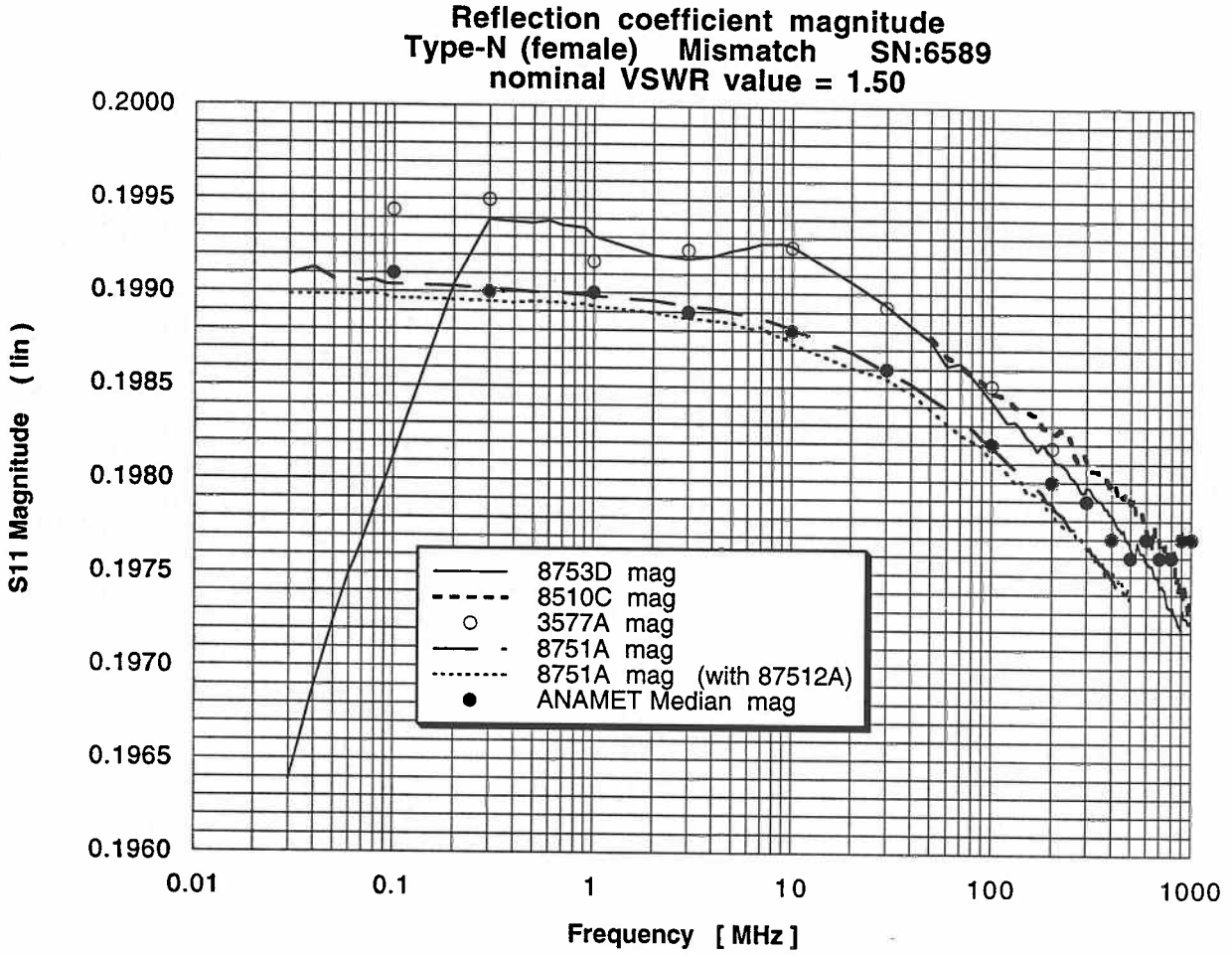

Reflection coefficient phase-difference from ANAMET median
Type-N (female) Mismatch SN:6753
nominal VSWR value = 1.05
S11 Phase Difference (degrees)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D - ANAMET Median
8510C - ANAMET Median
3577A - ANAMET Median
8751A - ANAMET Median
8751A (with 87512A) - ANAMET Median

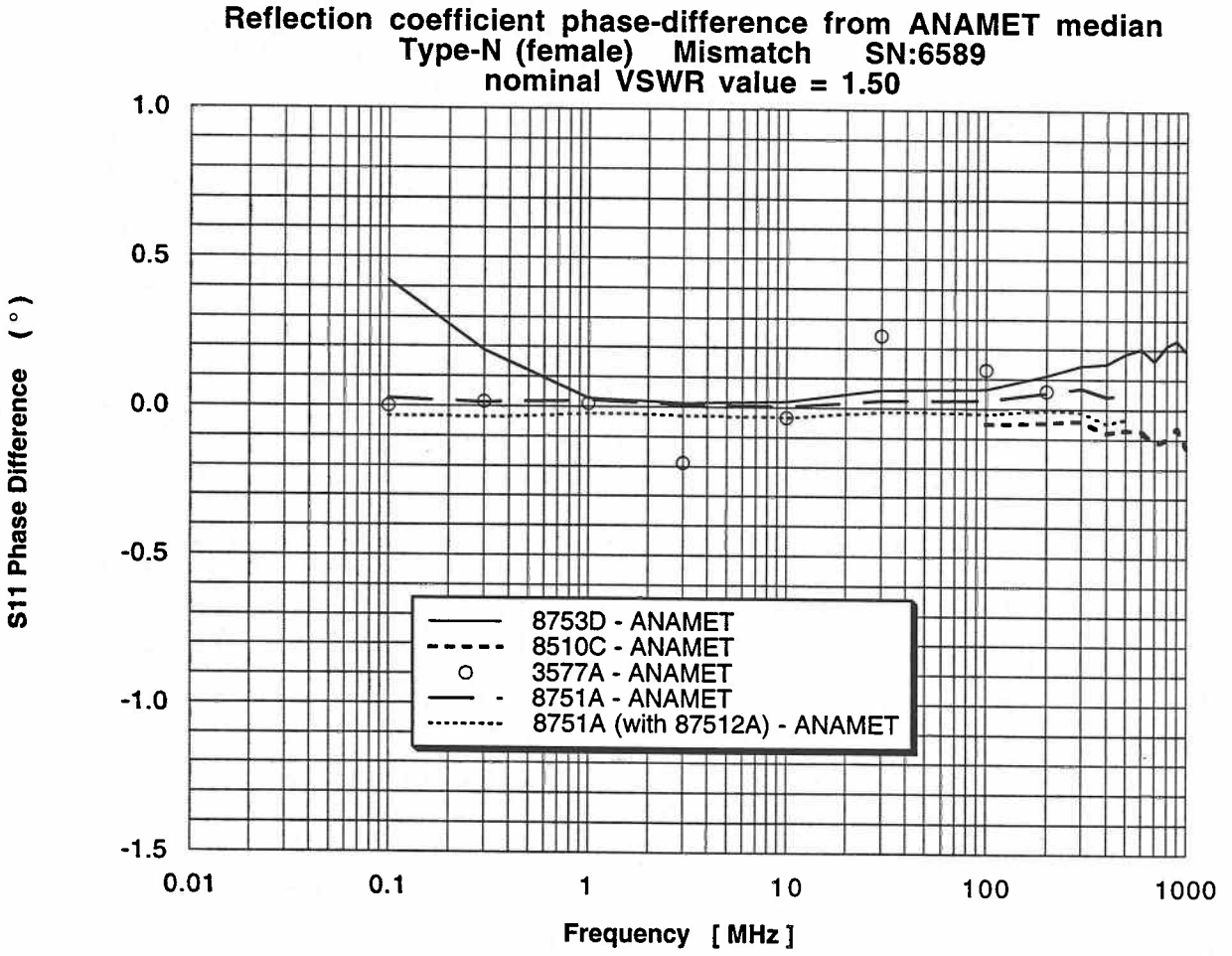
Reflection coefficient magnitude
Type-N (female) Mismatch SN:6585
nominal VSWR value = 1.20

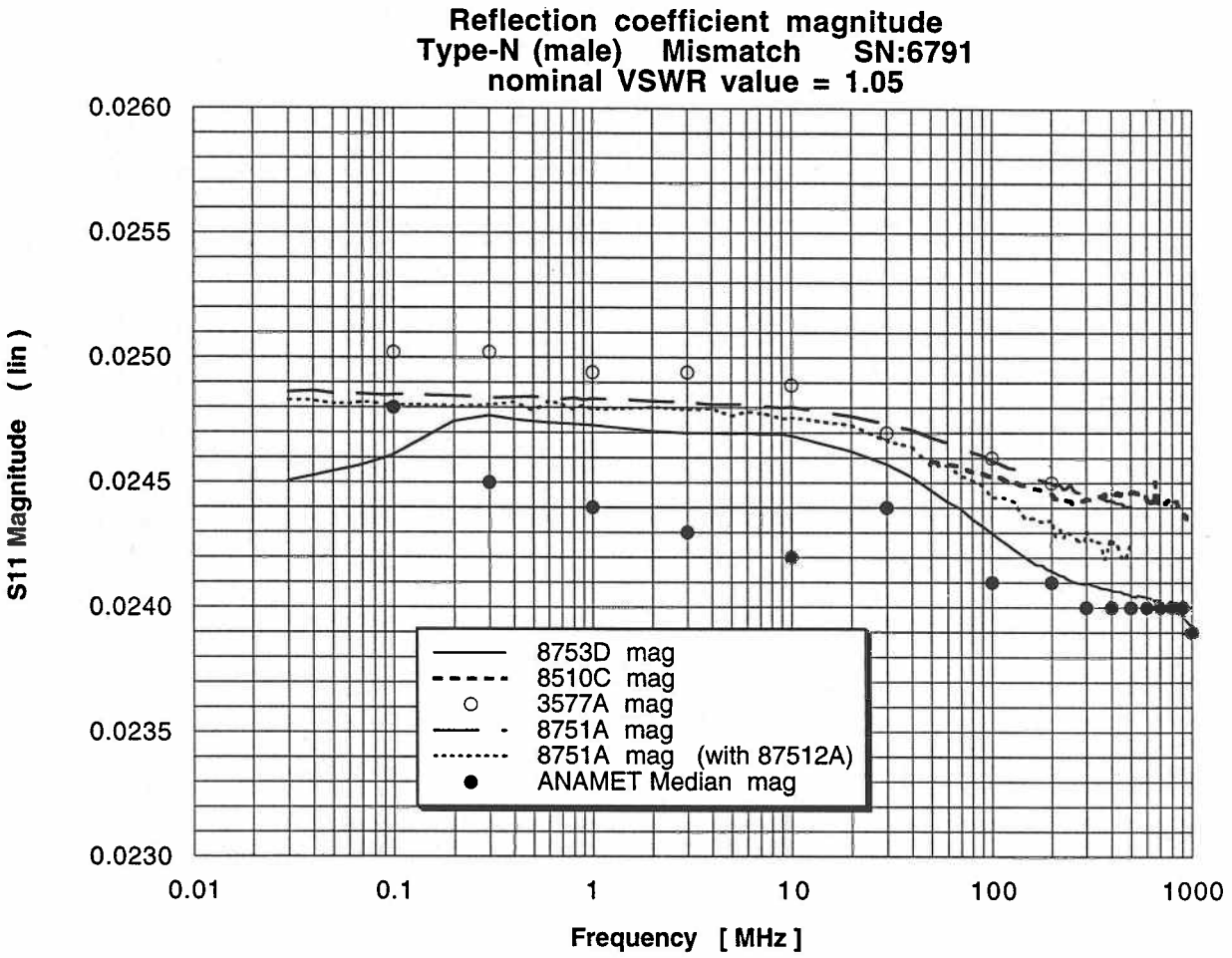


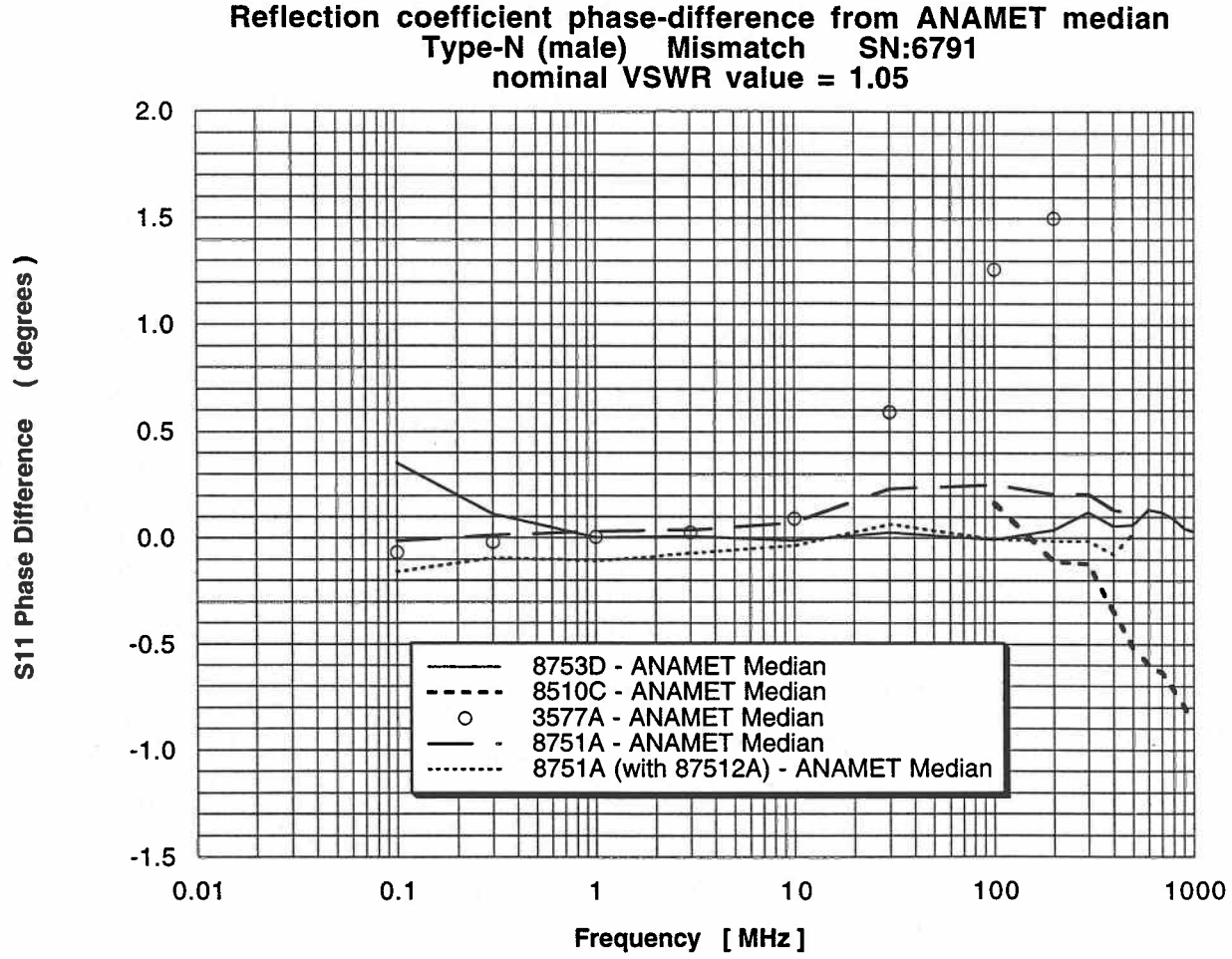
Reflection coefficient phase-difference from ANAMET median
Type-N (female) Mismatch SN:6585
nominal VSWR value = 1.20

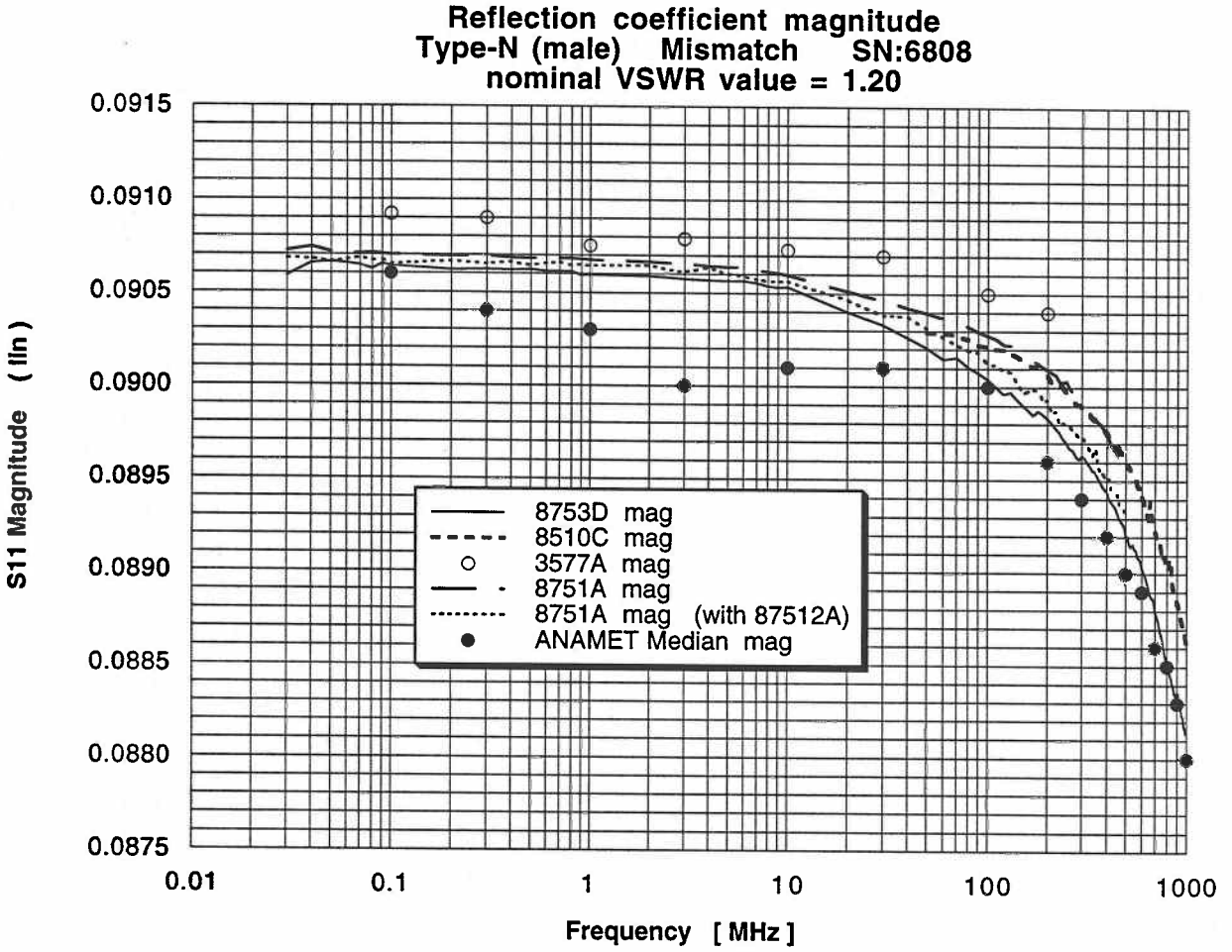


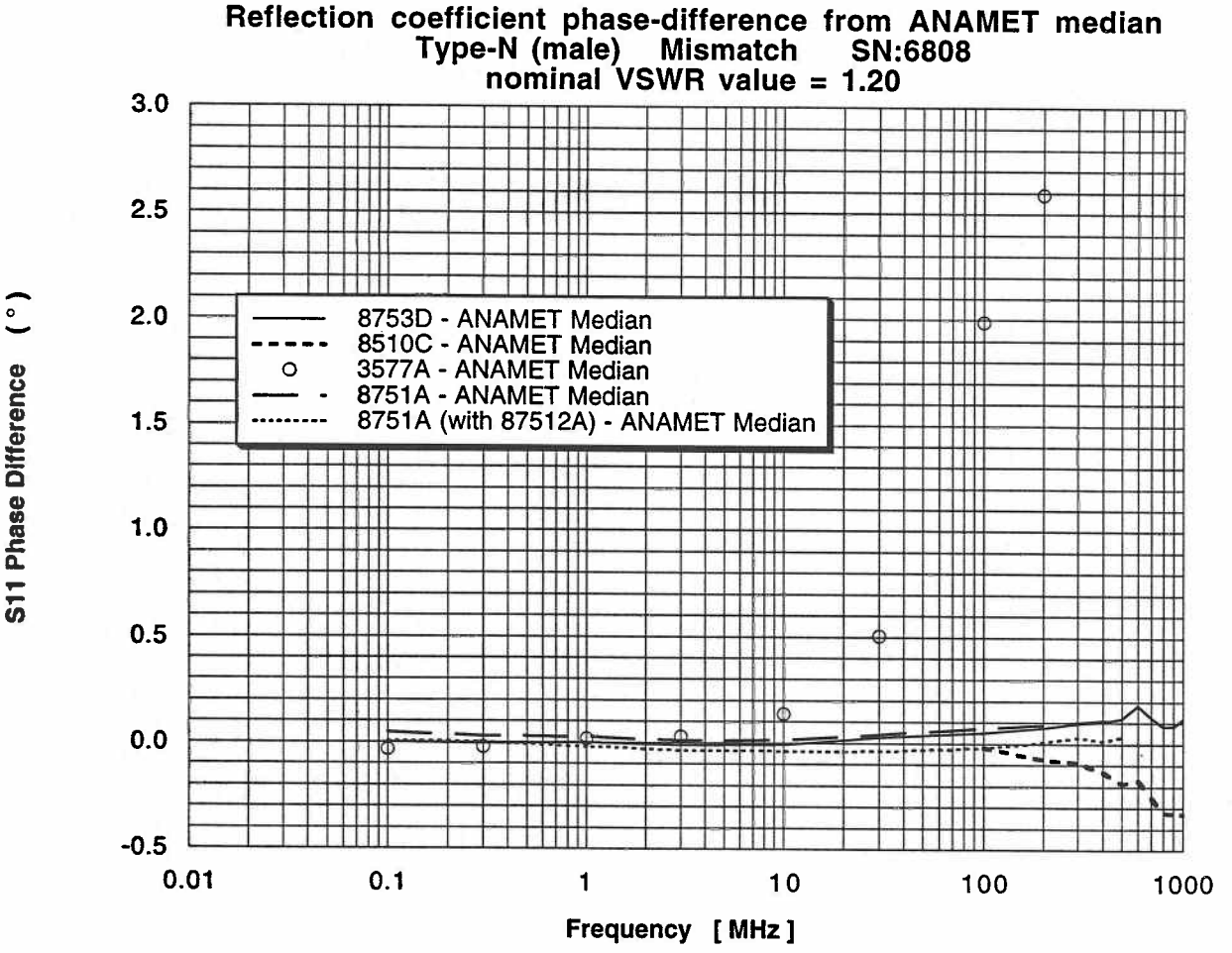

Reflection coefficient magnitude
Type-N (female) Mismatch SN:6589
nominal VSWR value = 1.50
S11 Magnitude (lin)
0.2000
0.1995
0.1990
0.1985
0.1980
0.1975
0.1970
0.1965
0.1960
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D mag
8510C mag
3577A mag
8751A mag
8751A mag (with 87512A)
ANAMET Median mag

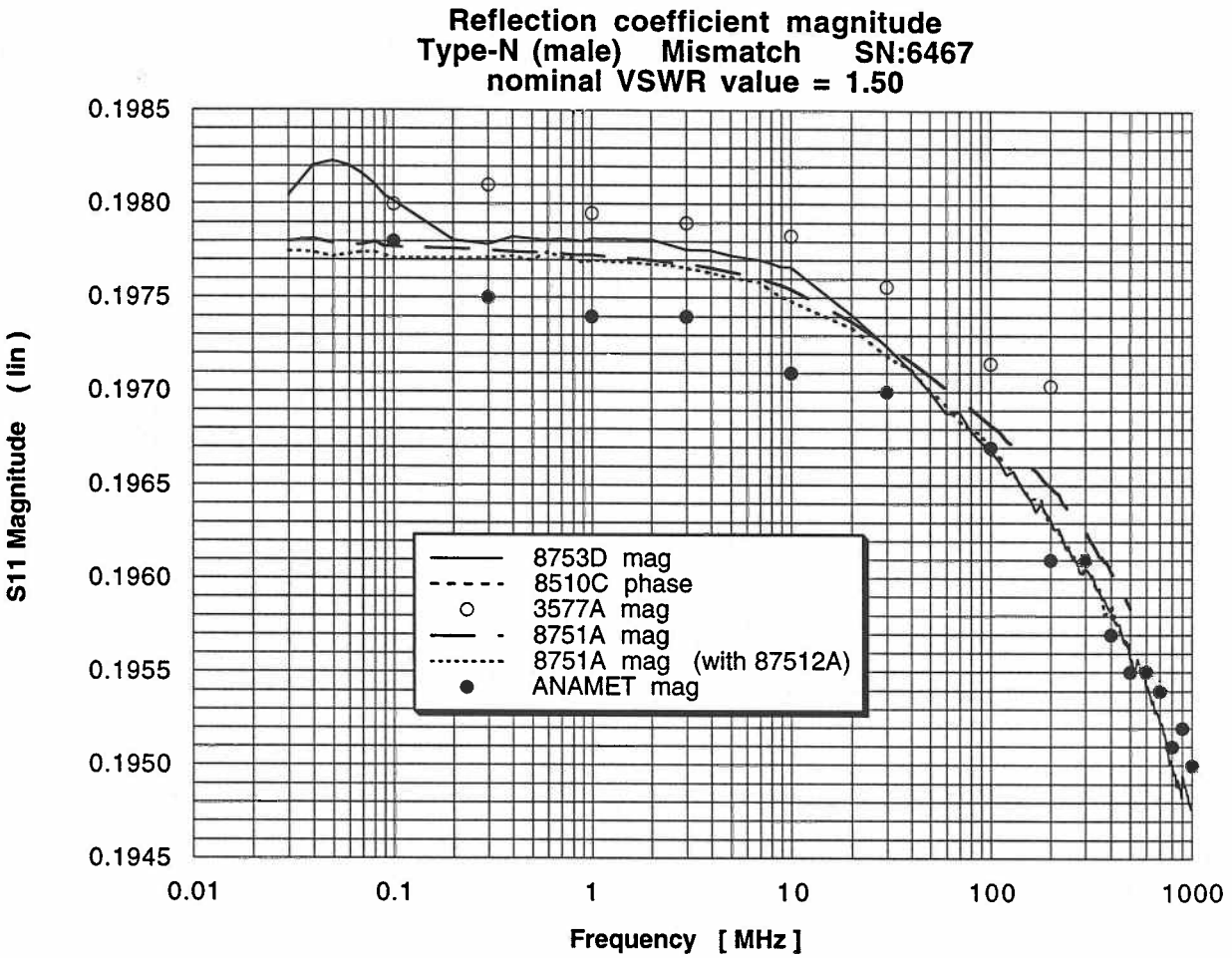

Reflection coefficient phase-difference from ANAMET median
Type-N (female) Mismatch SN:6589
nominal VSWR value = 1.50
S11 Phase Difference (°)
1.0
0.5
0.0
-0.5
-1.0
-1.5
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D - ANAMET
8510C - ANAMET
3577A - ANAMET
8751A - ANAMET
8751A (with 87512A) - ANAMET

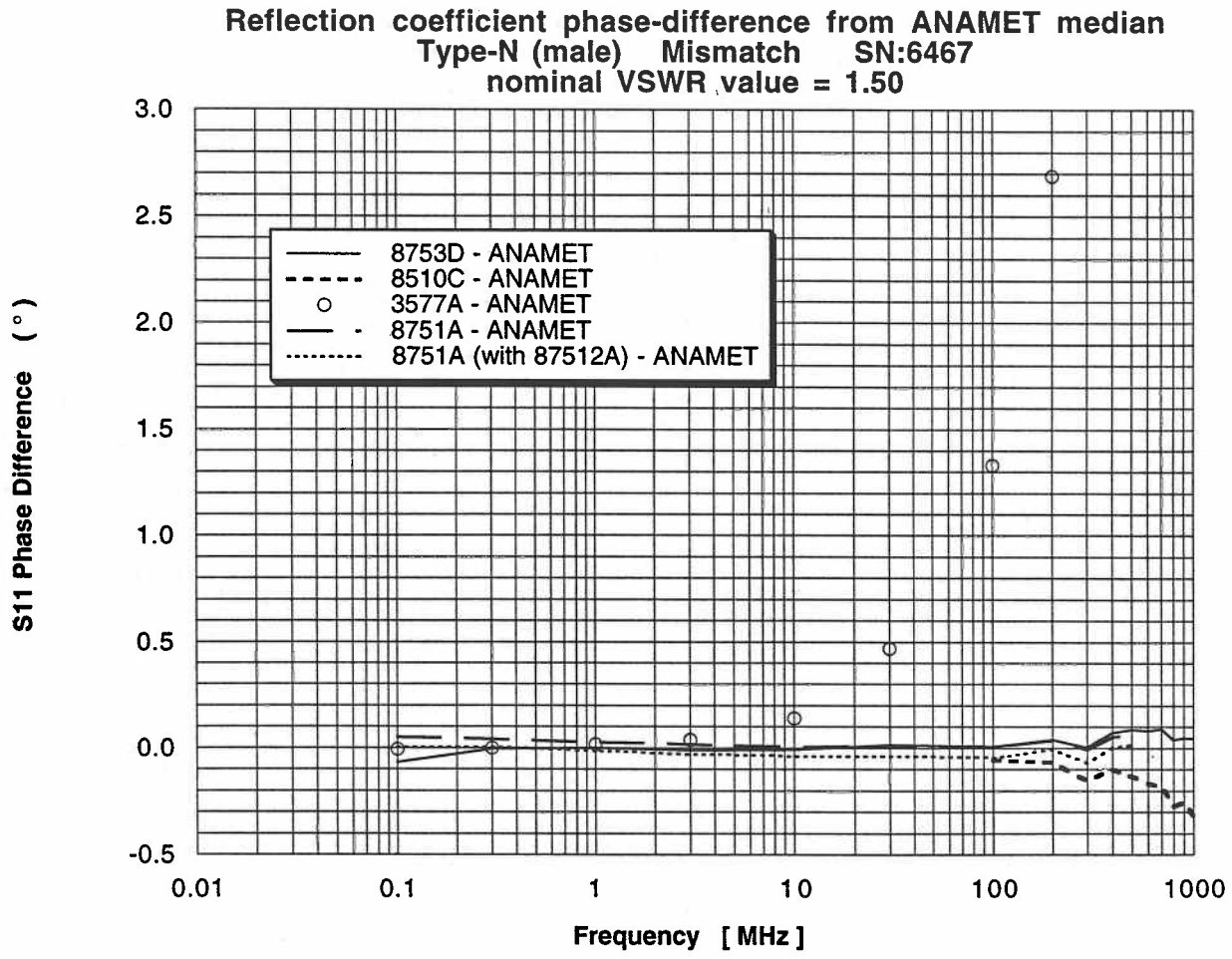

Reflection coefficient magnitude
Type-N (male) Mismatch SN:6791
nominal VSWR value = 1.05
S11 Magnitude (lin)
0.0260
0.0255
0.0250
0.0245
0.0240
0.0235
0.0230
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D mag
8510C mag
3577A mag
8751A mag
8751A mag (with 87512A)
ANAMET Median mag


Reflection coefficient phase-difference from ANAMET median
Type-N (male) Mismatch SN:6791
nominal VSWR value = 1.05
S11 Phase Difference (degrees)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D - ANAMET Median
8510C - ANAMET Median
3577A - ANAMET Median
8751A - ANAMET Median
8751A (with 87512A) - ANAMET Median


Reflection coefficient magnitude
Type-N (male) Mismatch SN:6808
nominal VSWR value = 1.20
S11 Magnitude (lin)
0.0915
0.0910
0.0905
0.0900
0.0895
0.0890
0.0885
0.0880
0.0875
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D mag
8510C mag
3577A mag
8751A mag
8751A mag (with 87512A)
ANAMET Median mag


Reflection coefficient phase-difference from ANAMET median
Type-N (male) Mismatch SN:6808
nominal VSWR value = 1.20
S11 Phase Difference (°)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D - ANAMET Median
8510C - ANAMET Median
3577A - ANAMET Median
8751A - ANAMET Median
8751A (with 87512A) - ANAMET Median


Reflection coefficient magnitude
Type-N (male) Mismatch SN:6467
nominal VSWR value = 1.50
S11 Magnitude (lin)
0.1985
0.1980
0.1975
0.1970
0.1965
0.1960
0.1955
0.1950
0.1945
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D mag
8510C phase
3577A mag
8751A mag
8751A mag (with 87512A)
ANAMET mag


Reflection coefficient phase-difference from ANAMET median
Type-N (male) Mismatch SN:6467
nominal VSWR value = 1.50
S11 Phase Difference (°)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0.01
0.1
1
10
100
1000
Frequency [MHz]
8753D - ANAMET
8510C - ANAMET
3577A - ANAMET
8751A - ANAMET
8751A (with 87512A) - ANAMET