TEST RESULTS OF NAUTEL AM IBOC HD TRANSMITTER PERFORMANCE VERSUS ANTENNA LOAD IMPEDANCE CHARACTERISTICS

PRESENTED TO
NRSC DAB SUBCOMMITTEE

BY
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APRIL 5, 2003

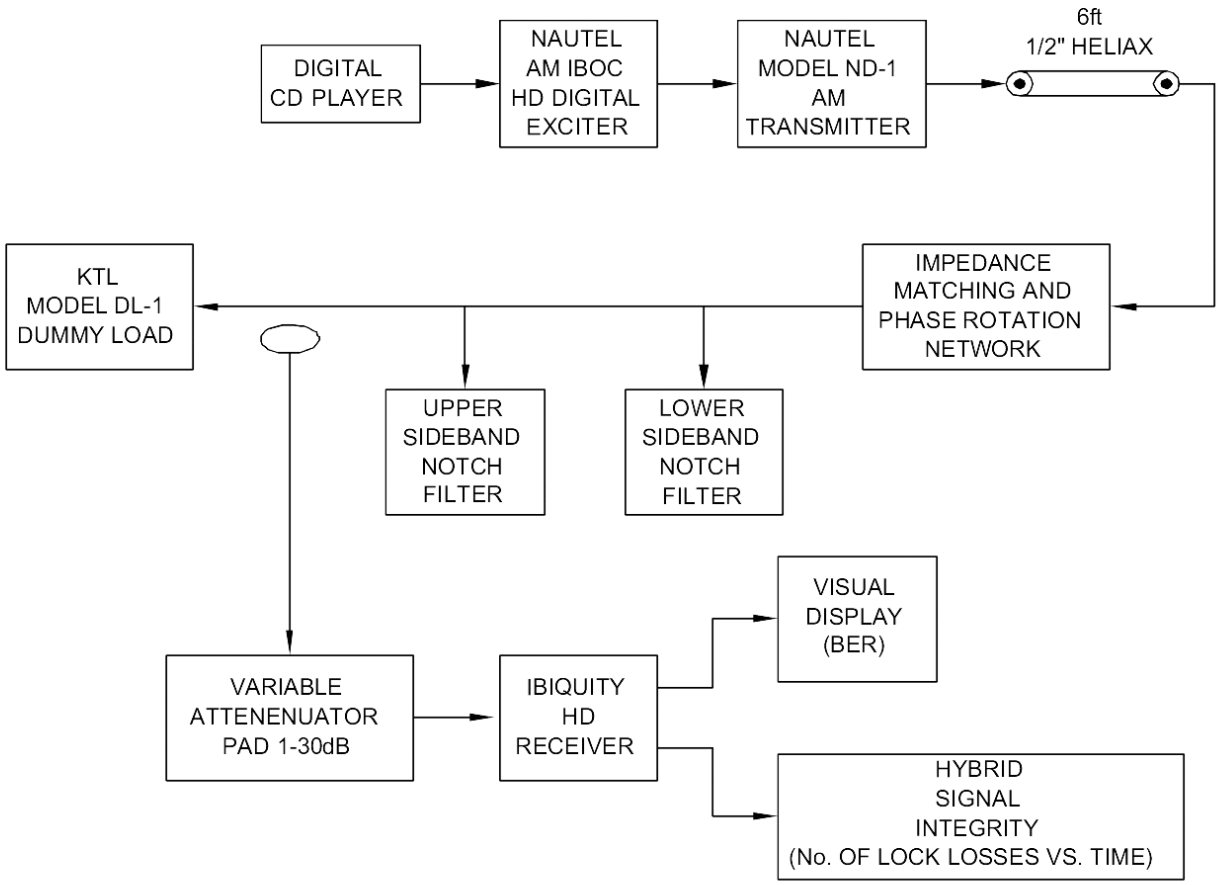
BACKGROUND

- NO AM ANTENNA SYSTEM REQUIREMENTS FOR HD RADIO SUBSTANTIATED BY DOCUMENTED TEST RESULTS HAVE BEEN PUBLISHED
- HD RADIO IS NOW BEING IMPLEMENTED IN THE US MARKET
- AS A LEADING PROVIDER OF AM ANTENNA SYSTEMS IN THE US MARKET, IT IS OF VITAL INTEREST TO KINTRONIC LABS TO PROVIDE ACCURATE DESIGN CRITERIA FOR HD TRANSMITTERS TO POTENTIAL CUSTOMERS

HD DAB TEST GOALS

- TO ASSESS THE EFFECTS OF ANTENNA LOAD SIDEBAND VSWR ON TRANSMITTER BIT ERROR RATE (BER)
- TO ASSESS THE EFFECTS OF ANTENNA LOAD CUSP ORIENTATION ON TRANSMITTER BER
- TO ASSESS THE EFFECTS OF ANTENNA LOAD SIDEBAND VSWR AND CUSP ORIENTATION ON RECEIVED AUDIO SIGNAL QUALITY, I.E., HYBRID, MARGINAL DIGITAL+ANALOG, OR ANALOG ONLY
- TO DEVELOP AM ANTENNA SYSTEM CRITERION FOR RELIABLE HD TRANSMISSION SYSTEM OPERATION

IBOC HD DAB
TEST SETUP BLOCK DIAGRAM



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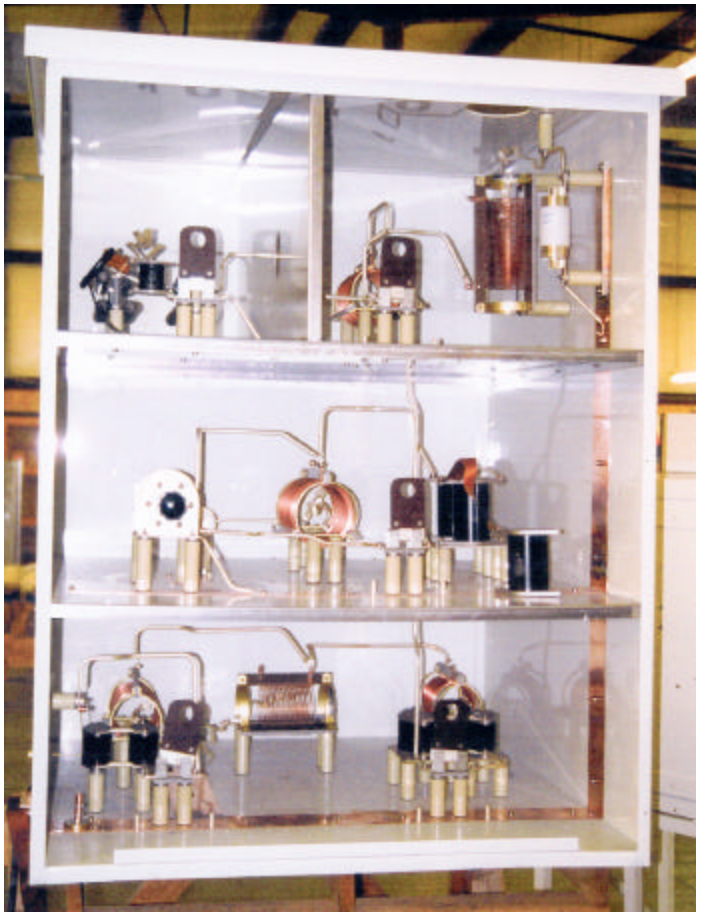
IBOC DAB
ANTENNA LOAD SIMULATOR



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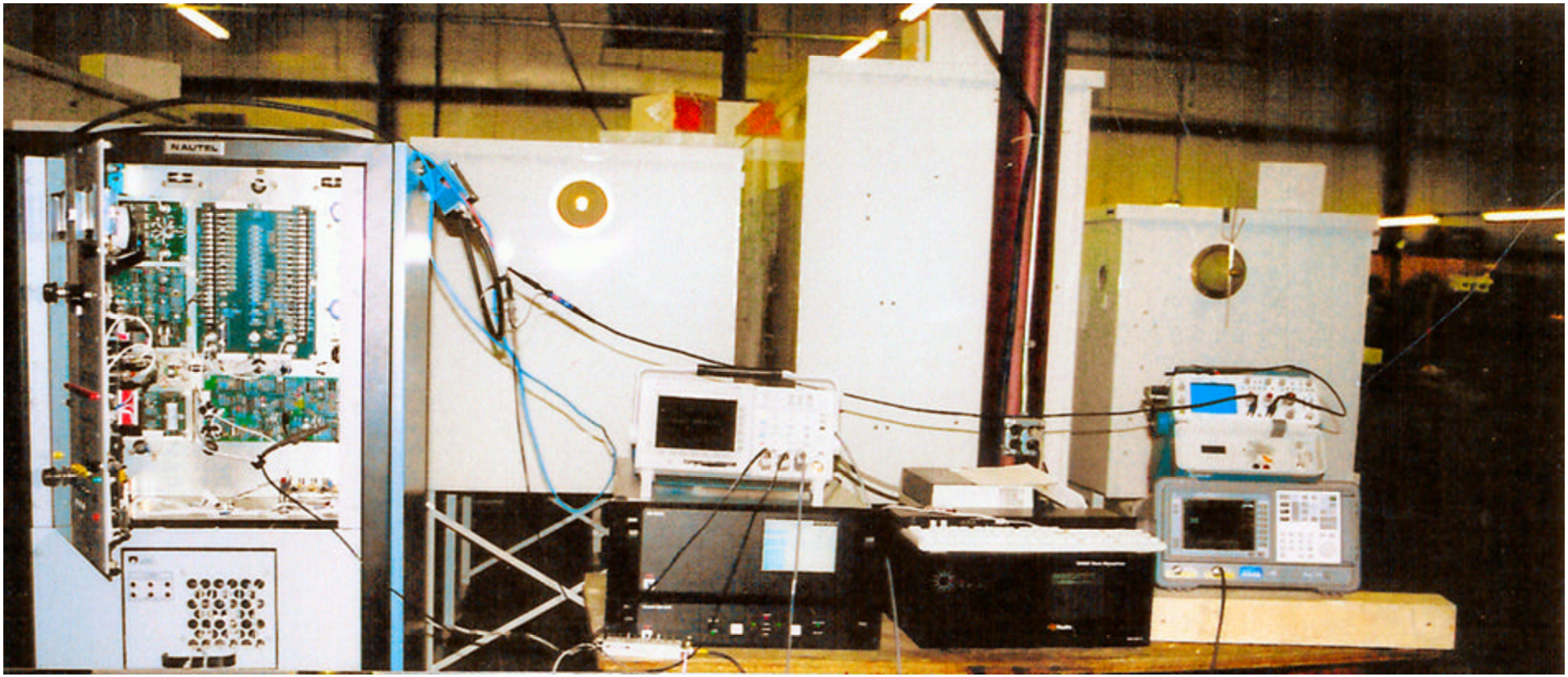
NAUTEL ND1 HD TRANSMITTER AND IBIQUITY RECEIVER



NAUTEL ND1 AM TRANSMITTER

NAUTEL AM IBOC EXCITER

IBIQUITY AM HD RECEIVER

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IBIQUITY HD TEST RECEIVER

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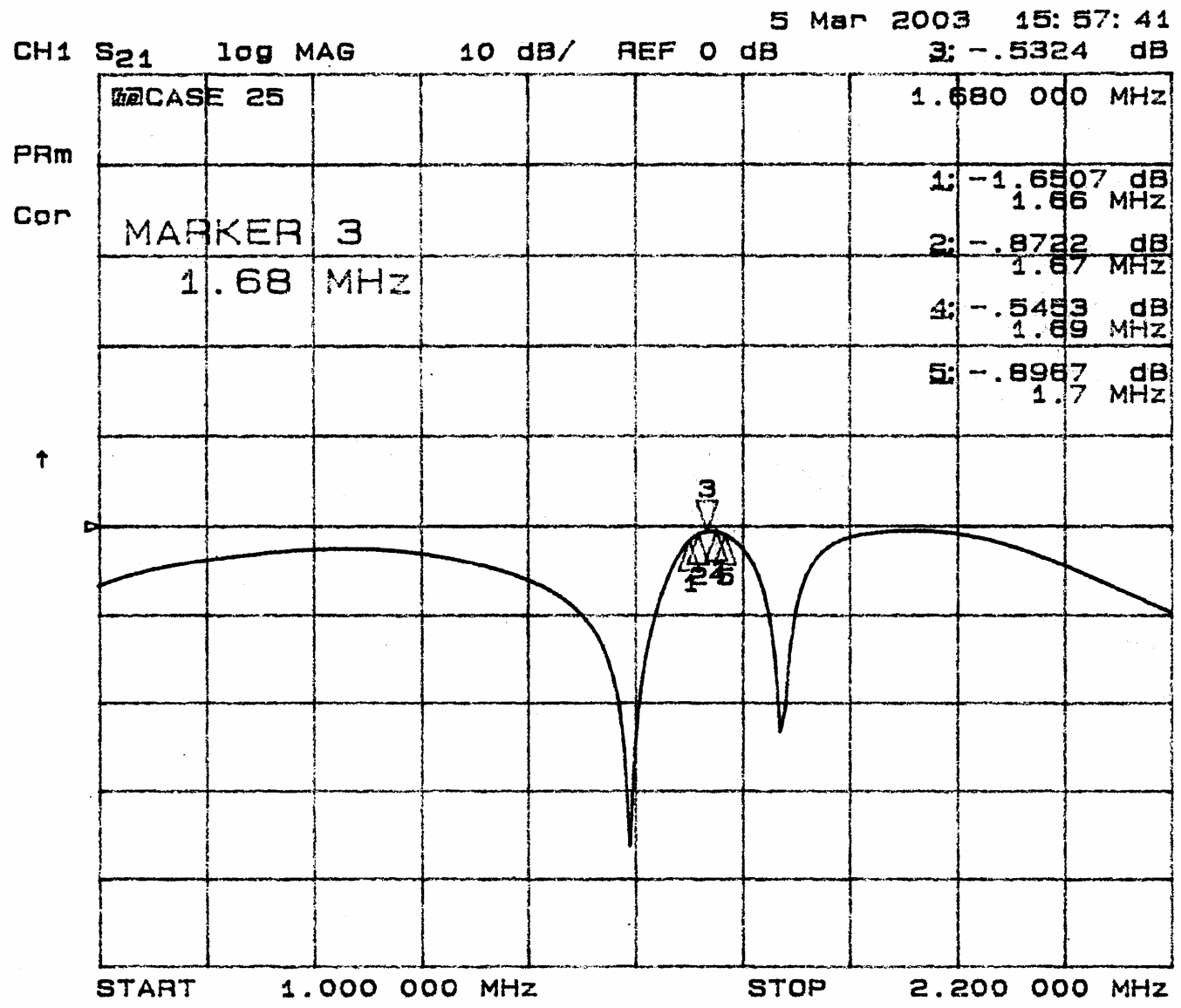
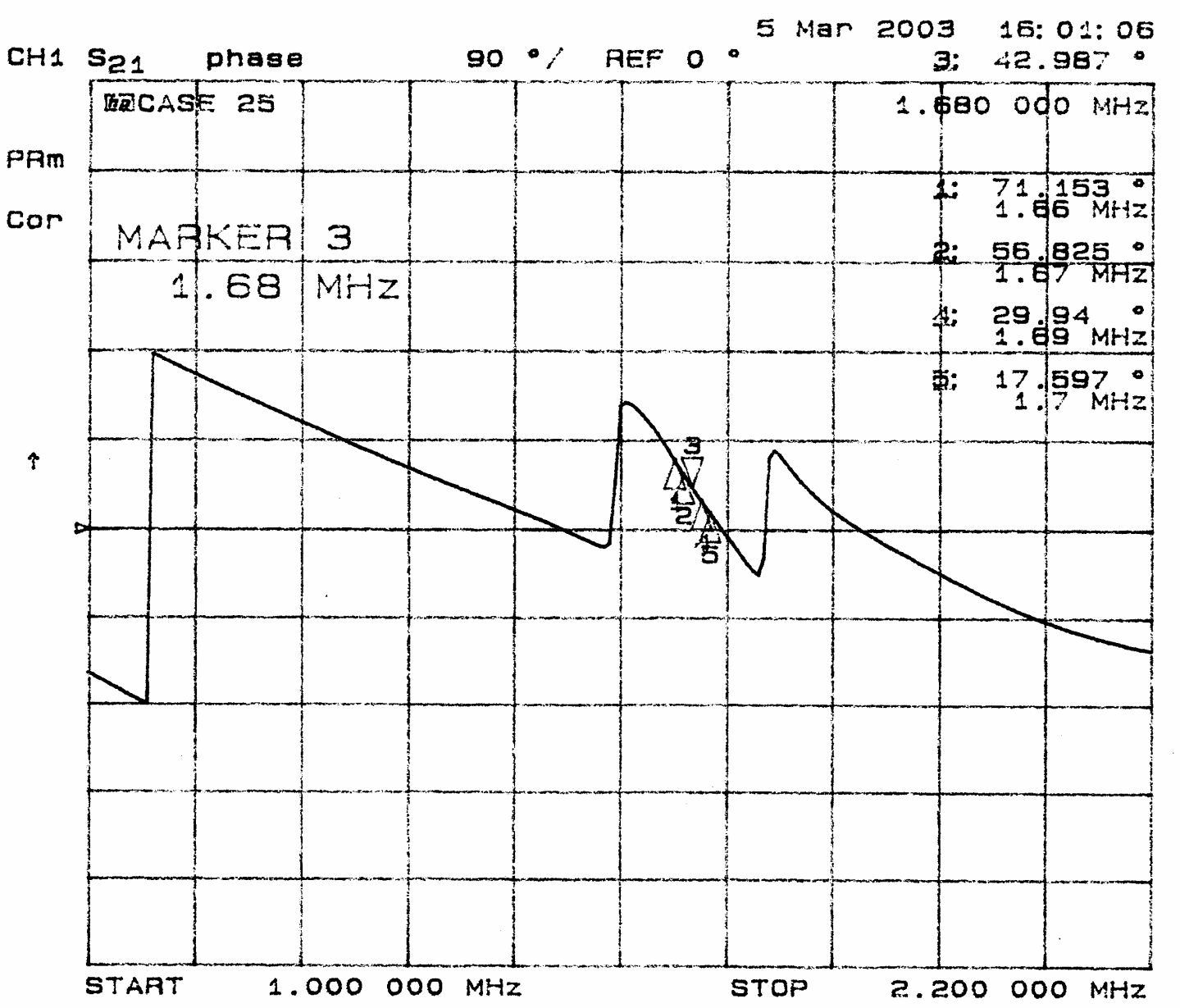
EXAMPLE OF SIMULATED ANTENNA LOAD PASSBAND SWEEP

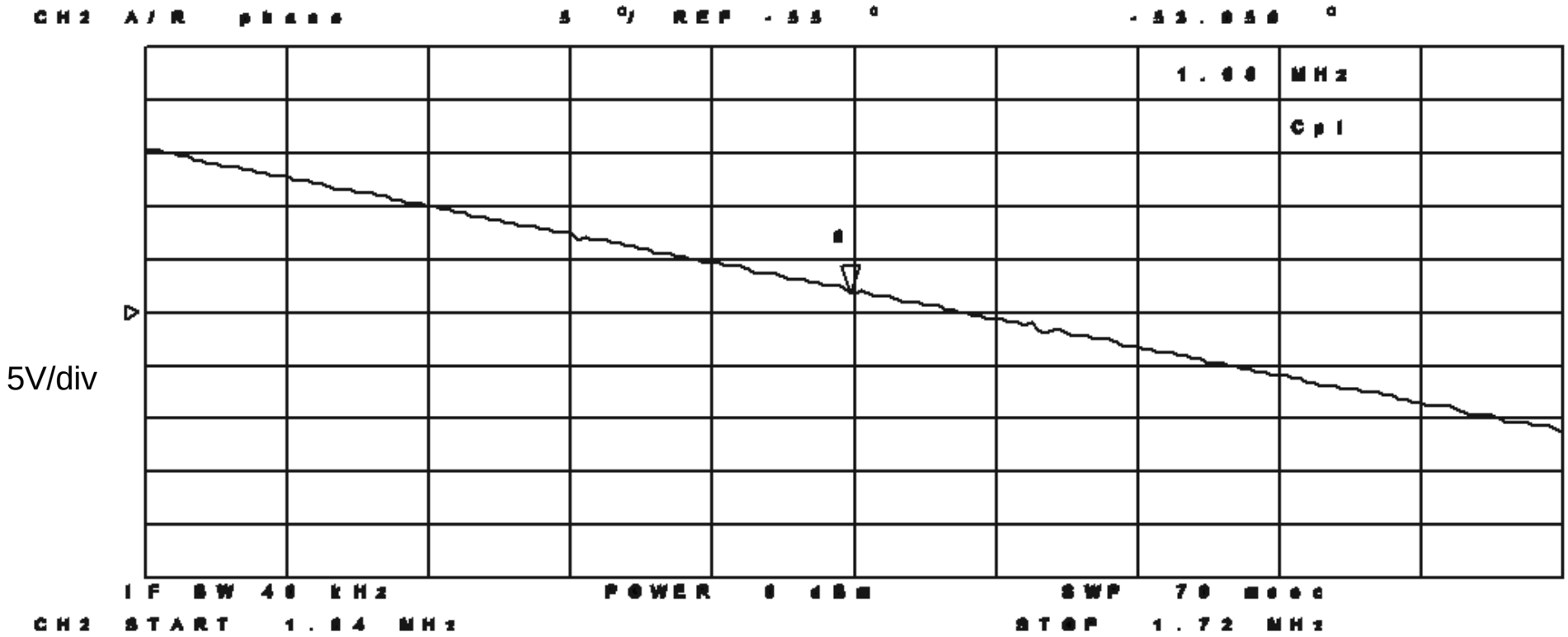


EXAMPLE OF SIMULATED ANTENNA LOAD PHASE SHIFT CHARACTERISTICS



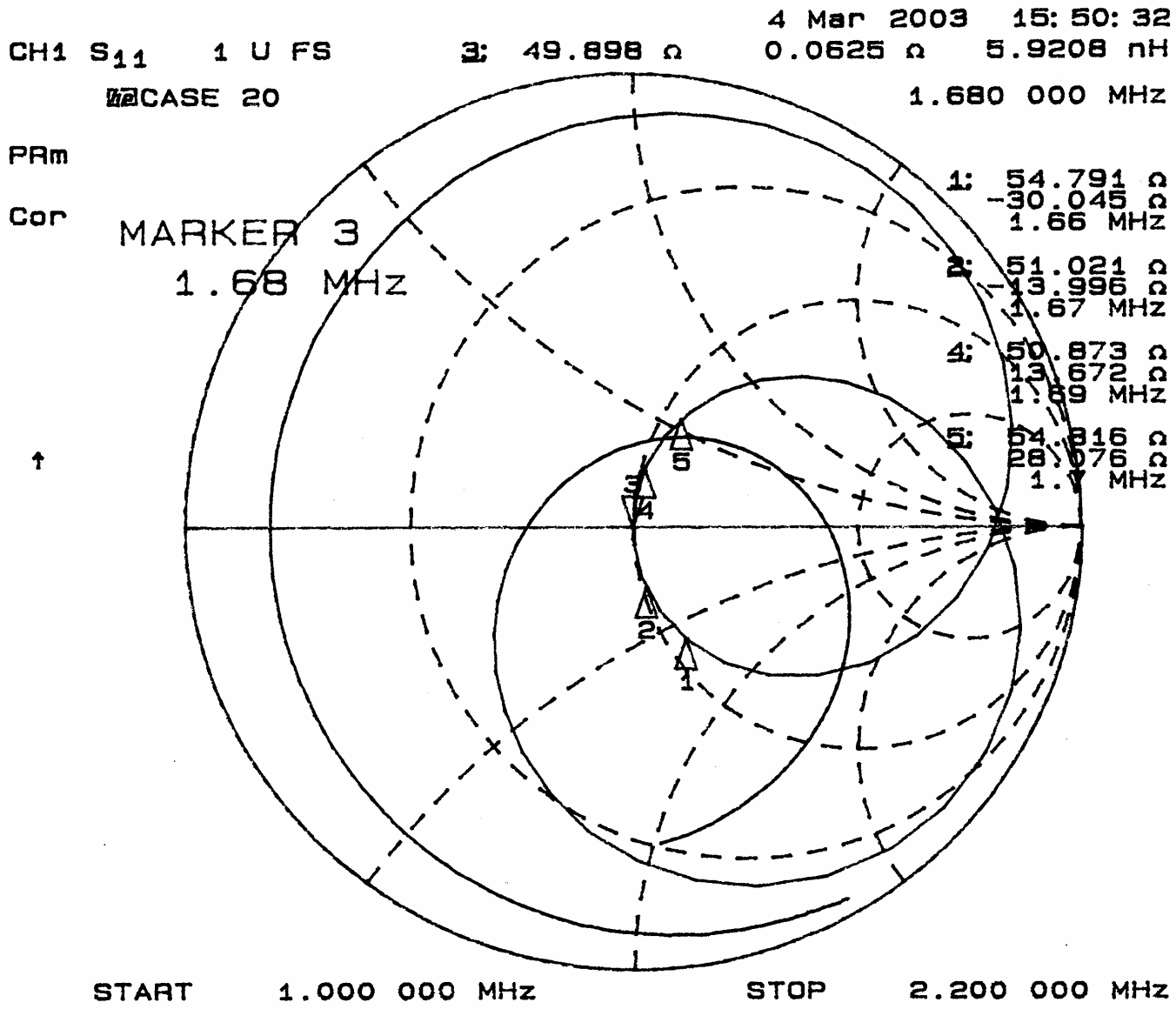
PHASE SHIFT OF ND1 OUTPUT NETWORK

-53°



*HP 4396 NETWORK ANALYZER PLOT

EXAMPLE OF 3:00 CUSP ROTATION



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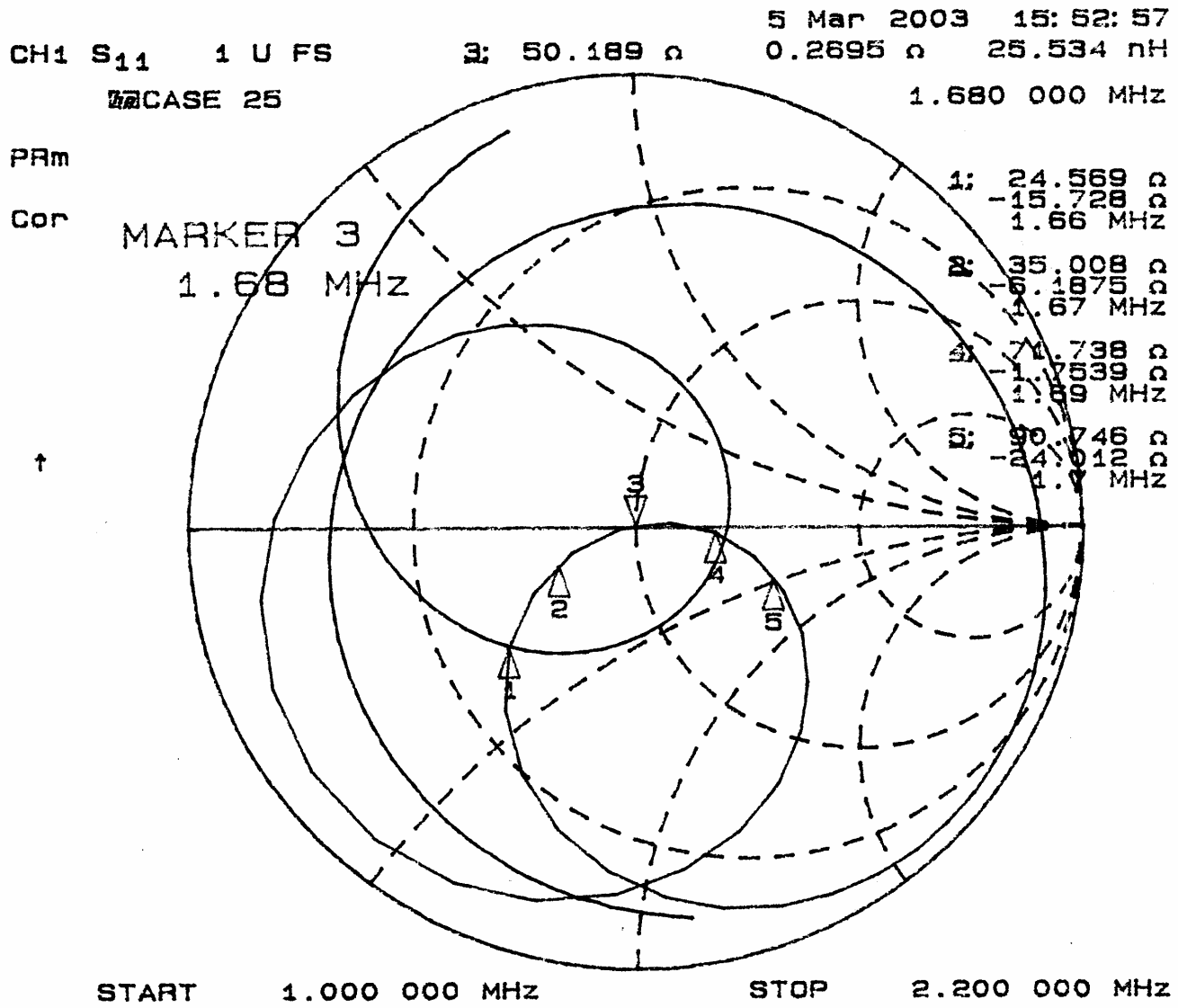
EXAMPLE OF 6:00 CUSP ROTATION



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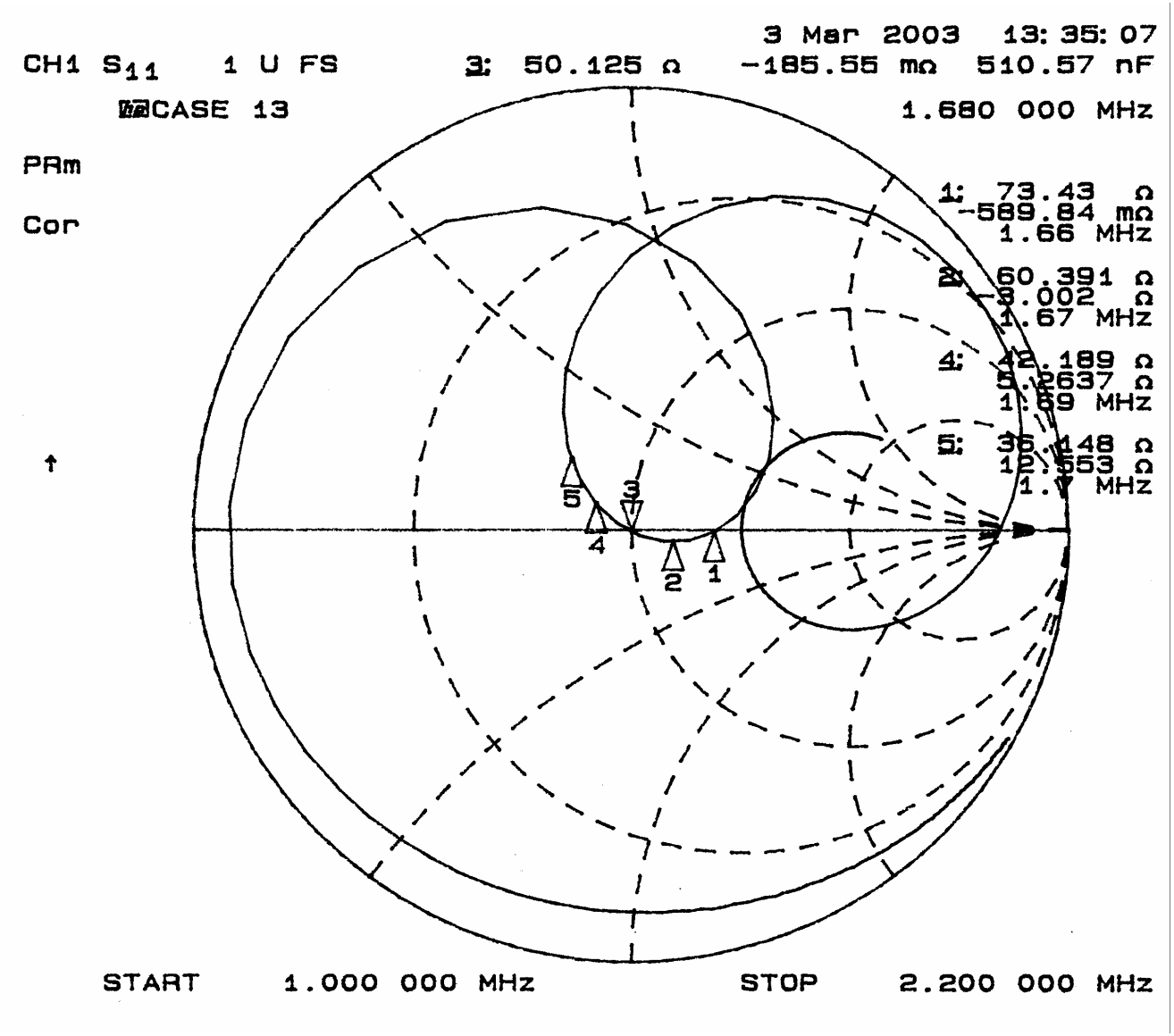
EXAMPLE OF 12:30 CUSP ROTATION



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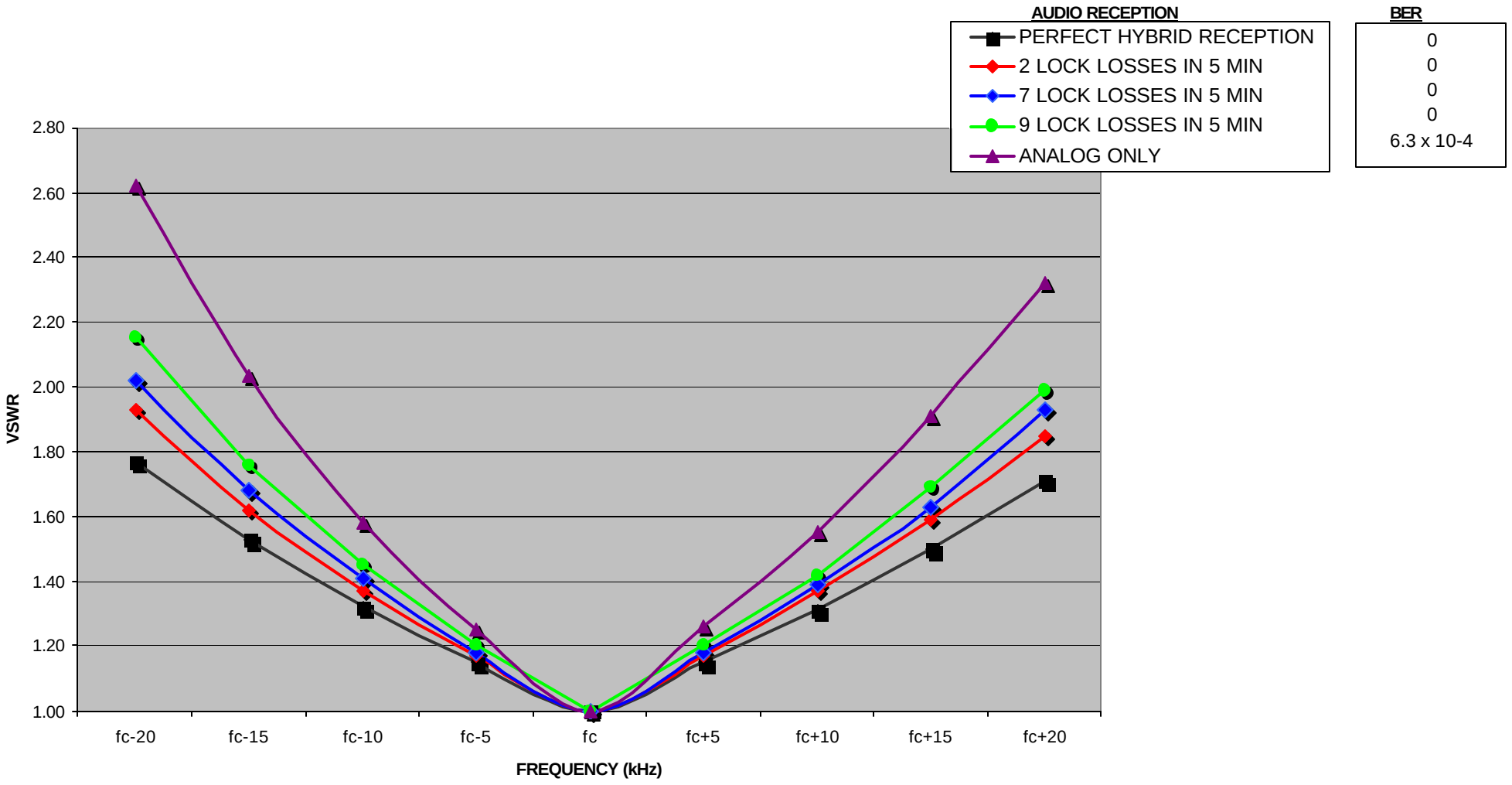
TEST RESULTS FOR 3:00 CUSP ROTATION



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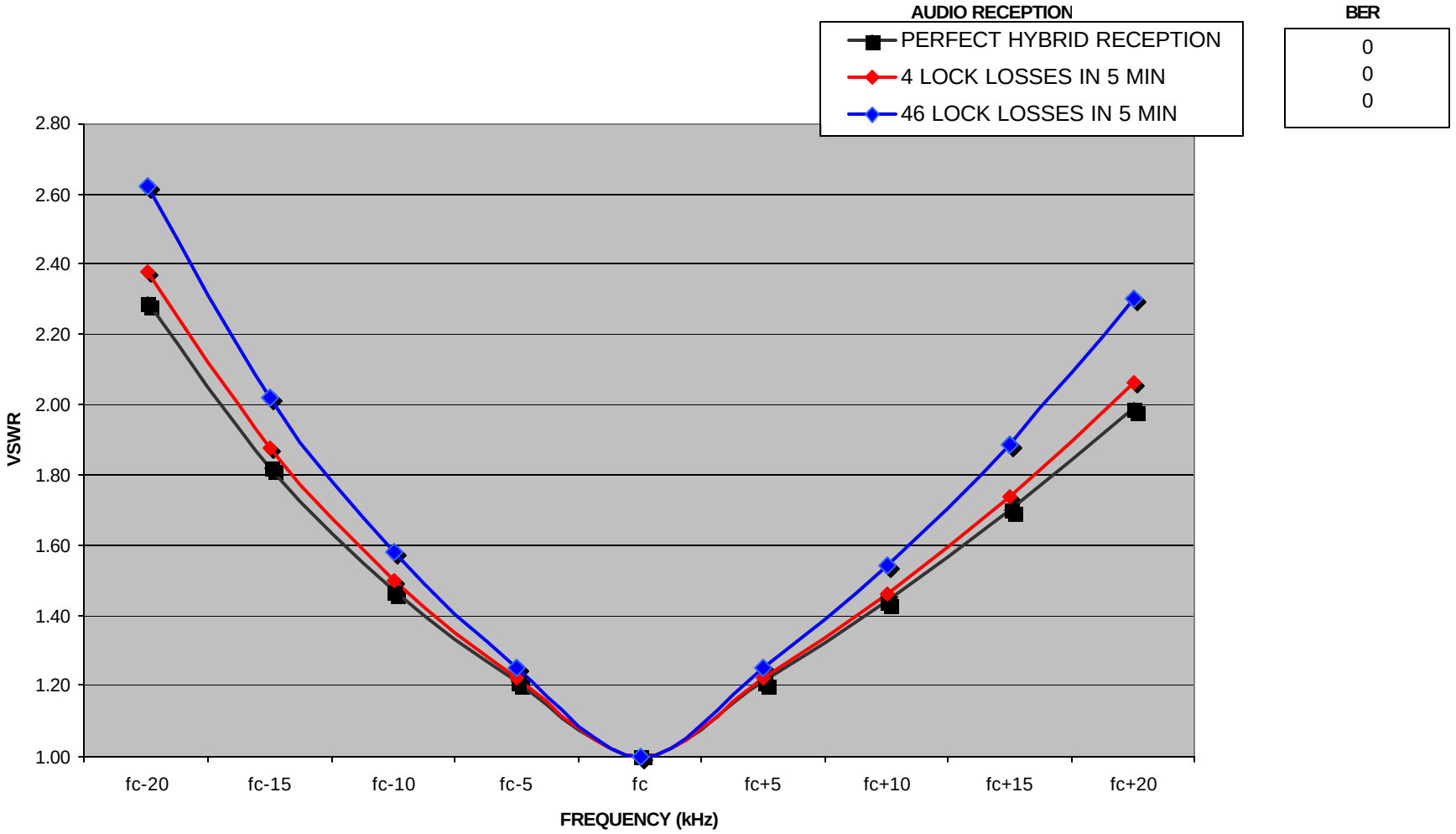
TEST RESULTS FOR 6:00 CUSP ROTATION



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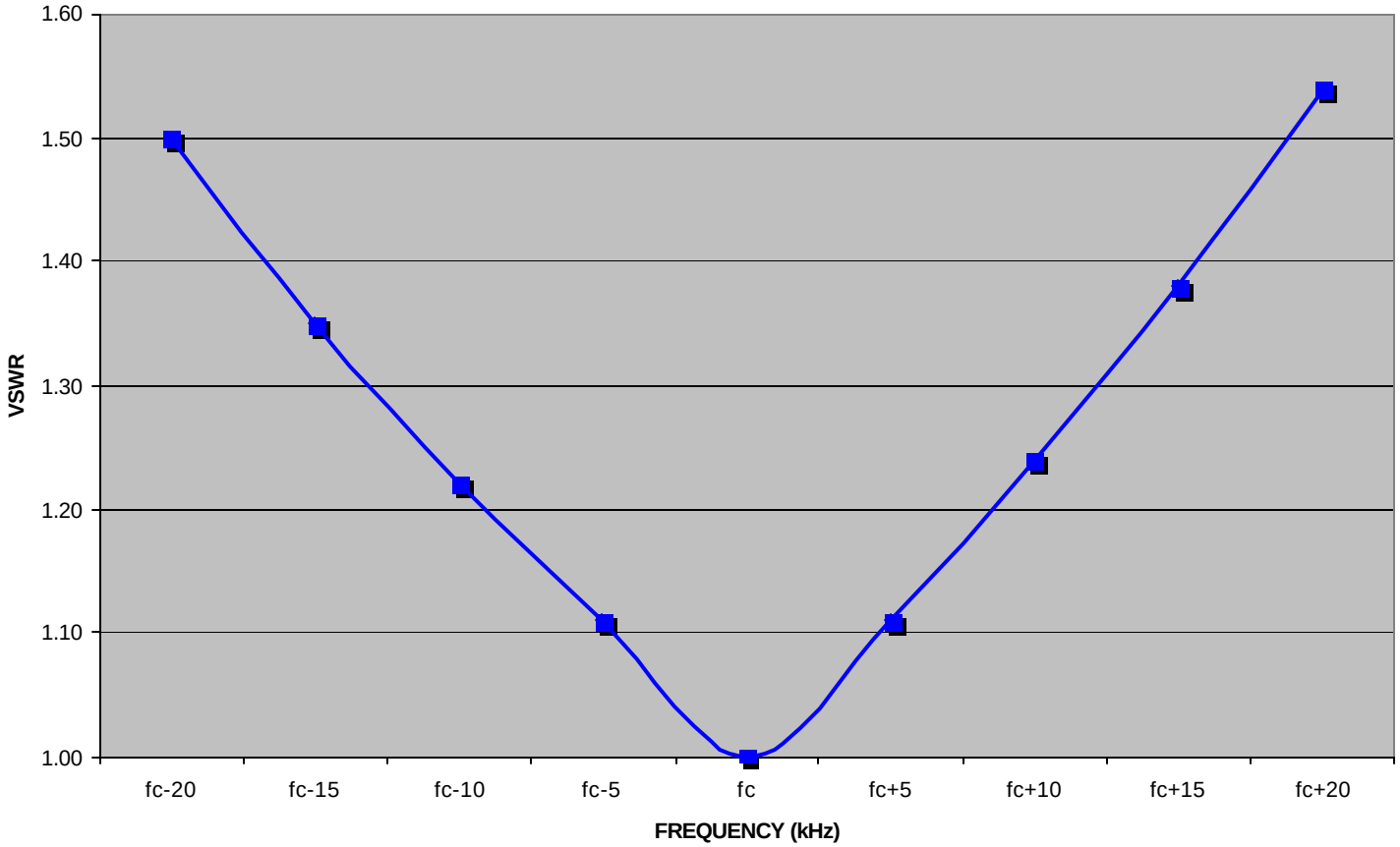
PERFECT HYBRID RECEPTION INDEPENDENT OF CUSP ROTATION FOR ILLUSTRATED PASSBAND



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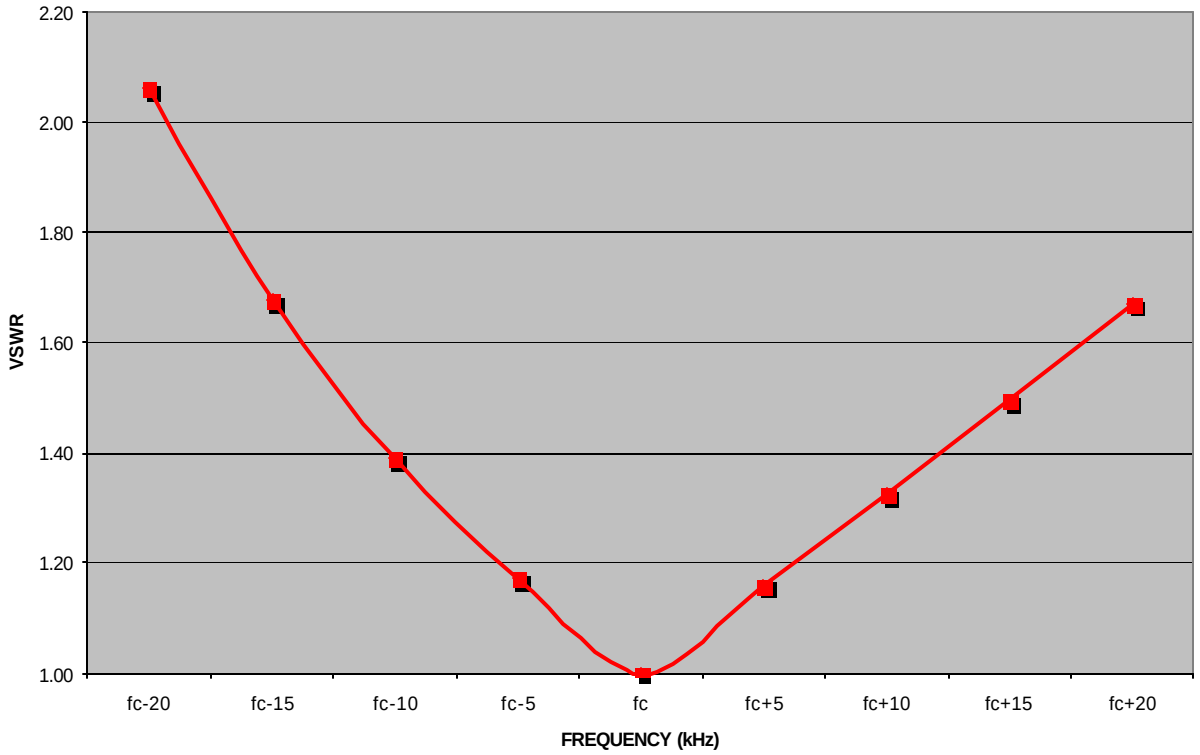
BER vs. CUSP ROTATION FOR +/- 10kHz VSWR < 1.4:1

CUSP ROTATION	BER	AUDIO QUALITY
3:00	0	PERFECT
2:30	8.9×10^{-6}	15 LOCK LOSSES/5MIN
2:00	5.2×10^{-6}	3.5 LOCK LOSSES/5MIN
1:30	3.0×10^{-5}	11 LOCK LOSSES/5MIN
12:30	4.8×10^{-5}	ANALOG ONLY



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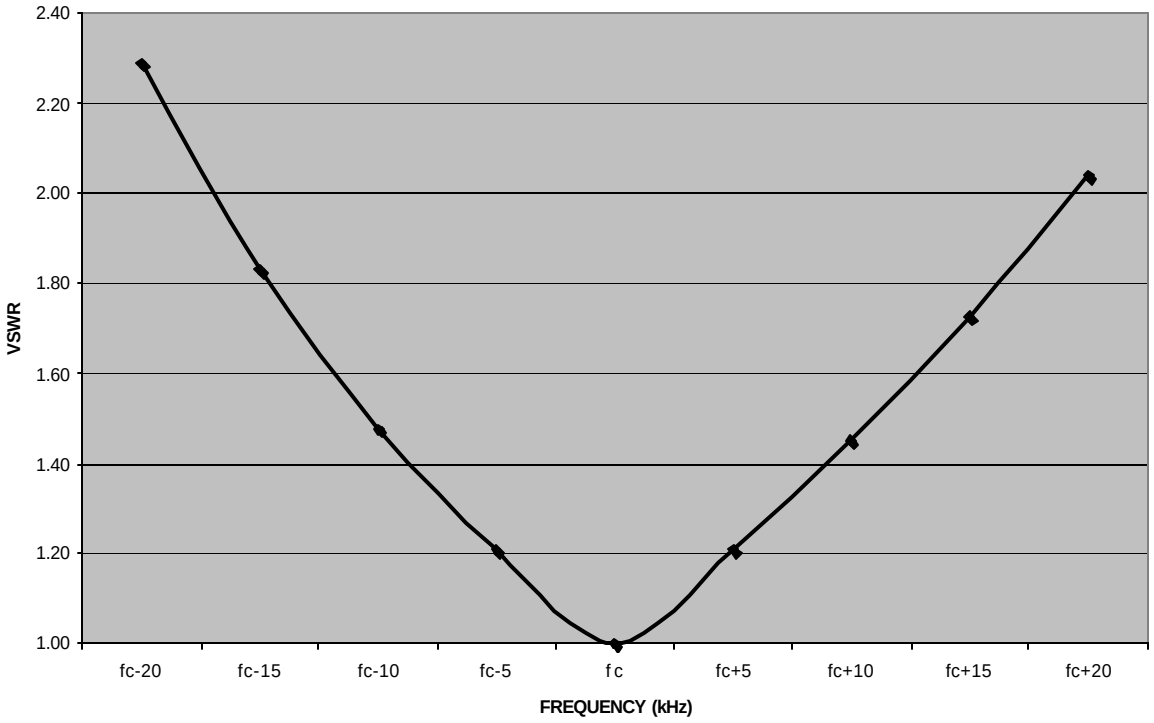
BER vs. CUSP ROTATION FOR +/- 10kHz VSWR < 1.5:1

CUSP ROTATION	BER	AUDIO QUALITY
6:00	0	PERFECT
5:00	0	1 LOCK LOSSES/5MIN
4:00	2.06×10^{-5}	7 LOCK LOSSES/5MIN
3:00	1.8×10^{-6}	35 LOCK LOSSES/5MIN



CONCLUSIONS

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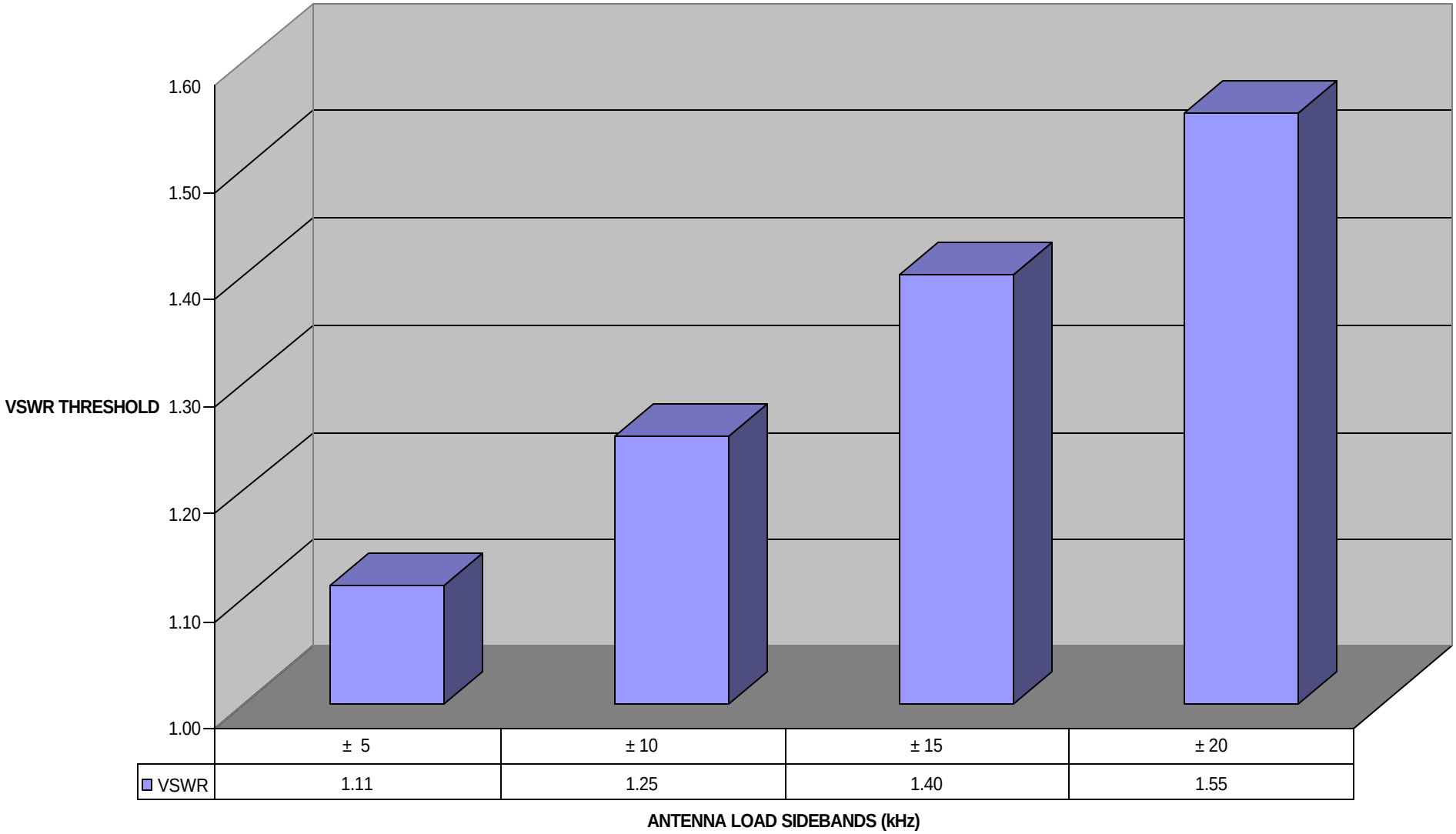
SIDEBAND VSWR THRESHOLD FOR PERFECT HYBRID DIGITAL + ANALOG RECEPTION INDEPENDENT OF CUSP ORIENTATION



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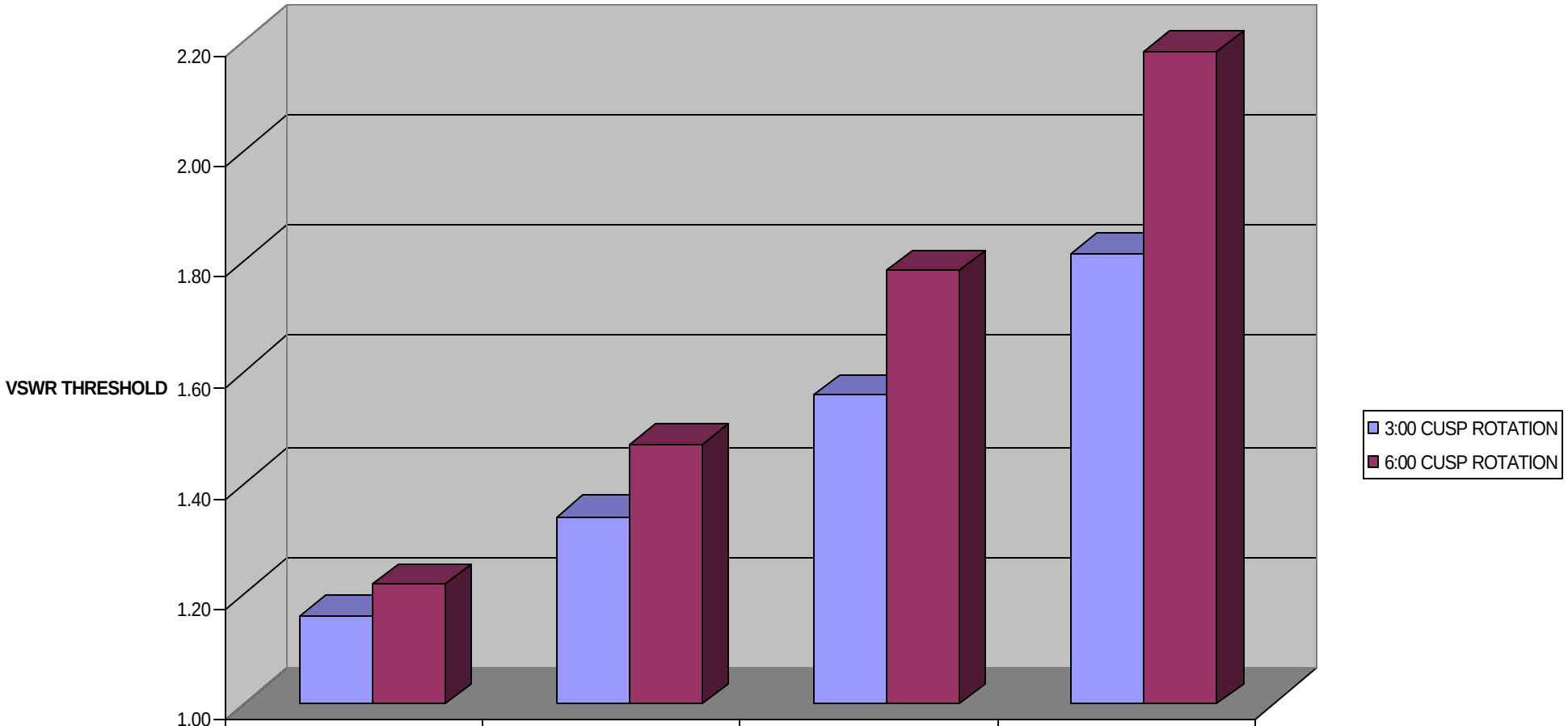
SIDEBAND VSWR THRESHOLD FOR PERFECT HYBRID DIGITAL +ANALOG RECEPTION FOR 3:00 AND 6:00 CUSP ORIENTATION



	± 5	± 10	± 15	± 20
3:00 CUSP ROTATION	1.16	1.34	1.56	1.82
6:00 CUSP ROTATION	1.22	1.47	1.79	2.18

ANTENNA LOAD SIDEBAND (kHz)

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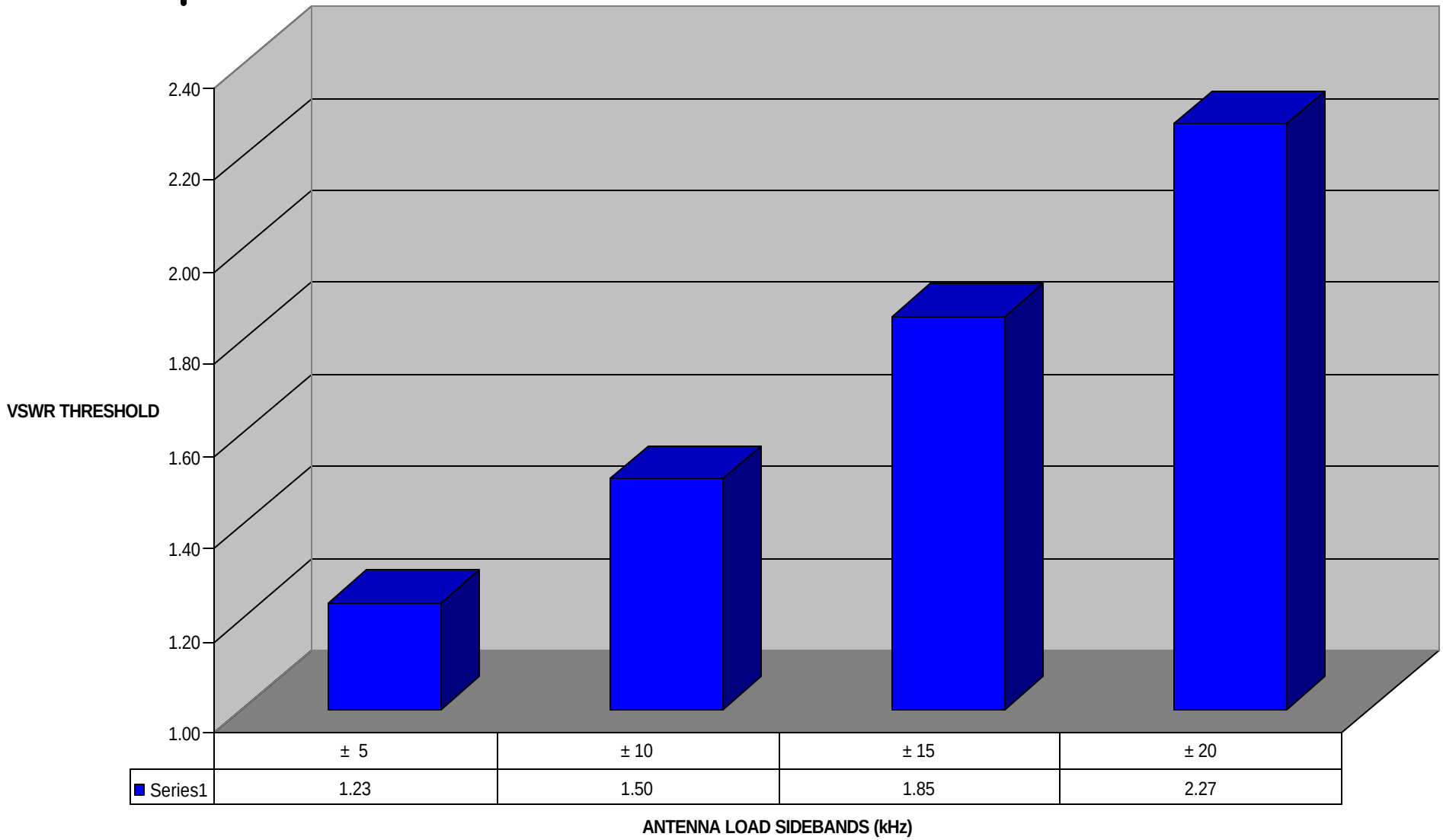
SIDEBAND VSWR THRESHOLD AT WHICH DIGITAL RECEPTION DROPOUT OCCURS FOR 3:00 CUSP ORIENTATION



GENERAL CONCLUSIONS

- ALL RESULTS SHOWN ARE CONCLUSIVE, EXCLUDING ANY PROPAGATION PATH EFFECTS
- ALL RESULTS SHOWN APPLY FOR THE NAUTEL ND1 TRANSMITTER, WHICH UNIQUELY UTILIZES AN OUTPUT NETWORK WITH ZERO PHASE SHIFT. OTHER TRANSMITTER MAKES AND MODELS MAY YIELD DIFFERENT RESULTS
- BIT ERROR RATE IS NOT A FULL INDICATOR OF DIGITAL RECEPTION QUALITY