

## CONTENTS

	Page
PREFACE . . . . .	iii
FIGURES . . . . .	vi
ABSTRACT . . . . .	1
1. INTRODUCTION . . . . .	1
1.1 Background . . . . .	1
1.2 Authority . . . . .	2
1.3 Purpose . . . . .	2
1.4 Extrapolation of Spectrum Occupancy Data . . . . .	2
2. OVERVIEW OF BROADBAND SPECTRUM SURVEYS . . . . .	3
2.1 Introduction . . . . .	3
2.2 Survey Site Selection . . . . .	3
2.3 Spectrum Survey Measurements . . . . .	4
3. SAN DIEGO SPECTRUM SURVEY . . . . .	13
3.1 Introduction . . . . .	13
3.2 Measurement Site Description . . . . .	13
3.3 Data Considerations . . . . .	17
3.4 Measured Data . . . . .	18
3.5 Observations on Measured Data and Spectrum Use . . . . .	59
4. REFERENCES . . . . .	68
A. APPENDIX A: RADIO SPECTRUM MEASUREMENT SYSTEM (RSMS) . . .	69
B. APPENDIX B: DATA ACQUISITION SOFTWARE . . . . .	79
C. APPENDIX C: INTERPRETATION OF SPECTRUM SURVEY DATA . . . . .	85
D. APPENDIX D: CALIBRATION OF THE MEASUREMENT SYSTEM . . . . .	99

## FIGURES

	Page
Figure 1. Area map of San Diego, California showing the location of the RSMS measurement site on Point Loma . . . . .	14
Figure 2. Area map of San Diego, California showing line-of-sight areas from the RSMS measurement site . . . . .	15
Figure 3. ITS Radio Spectrum Measurement System at Point Loma, San Diego, California . . . . .	16
Figure 4. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 108-138 MHz frequency range. . . . .	19
Figure 5. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 138-162 MHz frequency range. . . . .	20
Figure 6. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 162-174 MHz frequency range. . . . .	21
Figure 7. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 174-216 MHz frequency range. . . . .	22
Figure 8. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 216-225 MHz frequency range . . . . .	23
Figure 9. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 225-400 MHz frequency range . . . . .	24
Figure 10. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 400-406 MHz frequency range . . . . .	25
Figure 11. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 406-420 MHz frequency range . . . . .	26
Figure 12. Spectrum survey graph summarizing stepped measurements in the 420-450 MHz frequency range . . . . .	27
Figure 13. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 450-470 MHz frequency range . . . . .	28
Figure 14. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 470-512 MHz frequency range . . . . .	29

## **FIGURES (Continued)**

	Page
Figure 15. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 512-806 MHz frequency range . . . . .	30
Figure 16. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 806-902 MHz frequency range . . . . .	31
Figure 17. Spectrum survey graph summarizing swept measurements in the 902-928 MHz frequency range . . . . .	32
Figure 18. Spectrum survey graph summarizing stepped measurements in the 902-928 MHz frequency range . . . . .	33
Figure 19. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 928-960 MHz frequency range . . . . .	34
Figure 20. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 960-1215 MHz frequency range . . . . .	35
Figure 21. Spectrum survey graph summarizing stepped measurements in the 1215 -1400 MHz frequency range . . . . .	36
Figure 22. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 1350- 1400 MHz frequency range . . . . .	37
Figure 23. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 1400- 1530 MHz frequency range . . . . .	38
Figure 24. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 1530- 1710 MHz frequency range . . . . .	39
Figure 25. Spectrum survey azimuth-scan graph of measurements in the 1710-2300 MHz frequency range . . . . .	40
Figure 26. Spectrum survey graph summarizing swept measurements in the 2300-2500 MHz frequency range . . . . .	41
Figure 27. Spectrum survey azimuth-scan graph of measurements in the 2500-2700 MHz frequency range . . . . .	42
Figure 28. Spectrum survey graph summarizing stepped measurements in the 2700-2900 MHz frequency range . . . . .	43

## **FIGURES (Continued)**

	Page
Figure 29. Spectrum survey graph summarizing stepped measurements in the 2900-3100 MHz frequency range .....	44
Figure 30. Spectrum survey graph summarizing stepped measurements in the 3100-3700 MHz frequency range .....	45
Figure 31. Spectrum survey azimuth-scan graph of measurements in the 3700-4200 MHz frequency range .....	46
Figure 32. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 4200-4400 MHz frequency range .....	47
Figure 33. Spectrum survey azimuth-scan graph of measurements in the 4400-5000 MHz frequency range .....	48
Figure 34. Spectrum survey graph summarizing swept/m <sup>3</sup> measurements in the 5000-5250 MHz frequency range .....	49
Figure 35. Spectrum survey graph summarizing stepped measurements in the 5250-5925 MHz frequency range .....	50
Figure 36. Spectrum survey azimuth-scan graph of measurements in the 5925 -7125 MHz frequency range .....	51
Figure 37. Spectrum survey azimuth-scan graph of measurements in the 7125 -8500 MHz frequency range .....	52
Figure 38. Spectrum survey graph summarizing stepped measurements in the 8500-10550 MHz frequency range .....	53
Figure 39. Spectrum survey azimuth-scan graph of measurements in the 10550-13250 MHz frequency range .....	54
Figure 40. Spectrum survey graph summarizing stepped measurements in the 13250-14200 MHz frequency range .....	55
Figure 41. Spectrum survey azimuth-scan graph of measurements in the 14200- 15700 MHz frequency range .....	56
Figure 42. Spectrum survey graph summarizing stepped measurements in the 15700- 17700 MHz frequency range .....	57

## **FIGURES (Continued)**

	Page
Figure 43. Spectrum survey azimuth-scan graph of measurements in the 17700-19700 MHz frequency range .....	58
Figure A-1. Top and side view drawings of the RSMS .....	70
Figure A-2. Front panel of the RSMS instrument racks .....	71
Figure A-3. Block diagram of the RSMS receiver .....	72
Figure C-1. Functional diagram of the RSMS signal-processing path for cumulated data .....	89
Figure D-1. Example calibration graph of noise figure and correction factor curves ..	99
Figure D-2. Typical noise diode solid state noise source .....	100
Figure D-3. Lumped-component noise diode calibration schematic .....	101