

621.3825

En1

2010

*DESIGN AND CONSTRUCTION OF SATELLITE
COMMUNICATIONS DEMONSTRATOR*

Design Project

*ROSE ANN G. ENCABO
ALVIN U. SUMADSAD*

*College of Engineering and Information Technology
CAVITE STATE UNIVERSITY
Indang, Cavite*

CvSU Indang Campus (Main Library)



DP320

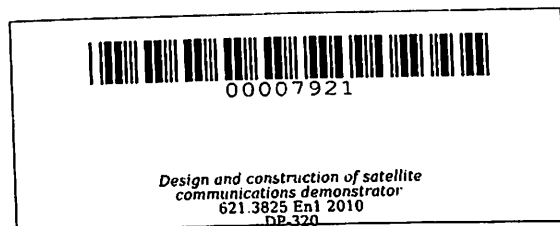
DP 621.3825 En1 2010

May 2010

**DESIGN AND CONSTRUCTION OF SATELLITE
COMMUNICATIONS DEMONSTRATOR**

Undergraduate Design Project
Submitted to the Faculty of
Cavite State University
Indang, Cavite

In partial fulfillment
of the requirements for the degree of
Bachelor of Science in Electronics and Communications Engineering



ROSE ANN C. ENCABO
ALVIN U. SUMADSAD

May 2010

ABSTRACT

ENCABO, ROSE ANN C. and SUMADSAD, ALVIN U. Design and Construction of Satellite Communications Demonstrator. Undergraduate Design Project. Bachelor of Science in Electronics and Communications Engineering. Cavite State University, Indang, Cavite. May 2010. Adviser: Engr. Michael T. Costa

The Design and Construction of Satellite Communications Demonstrator was conducted at Cavite State University Main Campus, Indang, Cavite from October 2009 to February 2010. The main objective of the project was to design and construct a Satellite Communications Demonstrator. Specifically, it aimed to demonstrate the concept of satellite communications system by providing three separate stations. It aimed to illustrate the principle and function of satellite by using a light as a medium. Moreover, it aimed to demonstrate the process of satellite communications and its function of being a repeater.

The designed Satellite Communications Demonstrator has three different stations: the originating ground station (transmitter), the satellite station, and the destination ground station (receiver). The transmitter has an input channel for an audio inputs and the receiver has an available channel for speaker outputs. The circuitry of the device was designed with built-in potentiometer to adjust the sensitivity of each station.

The design project was setup and evaluated at the Department of Computer and Electronics Engineering Laboratory Room of College of Engineering and Information Technology. During the evaluation, the adviser and the technical critic examined the device. The device was setup with MP3 player and a 4 Ω 3W speaker. To evaluate

whether the input signal (audio/sound) coming from the originating ground station will reach the destination ground station through the satellite station. Oscilloscope was used to observe the output waveform of the audio/sound.

The device was also evaluated using the function generator as an input and the output was observed using the oscilloscope. The test tone frequency of 1kHz with an amplitude or voltage of 1V was used to test the capabilities of the device. The distances between the stations were varied to further evaluate the efficiency, reliability and accuracy of the device. Channel one of the oscilloscope was connected to the output of the receiver in satellite station and channel two was connected to the output of the receiver station. Input and output waveforms were observed and analyzed to see the behavior of the device. Input and output voltages were also measured to be able to compute the attenuation on each given distance.

Results of the waveforms and computed values of attenuation proved that the device is working in accordance to what is expected. As the distance or length goes higher the attenuation and losses also goes higher.

TABLE OF CONTENTS

	Page
BIOGRAPHICAL DATA.....	iii
ACKNOWLEDGMENT.....	iv
ABSTRACT.....	vi
LIST OF FIGURES.....	xi
LIST OF APPENDIX FIGURES.....	xii
INTRODUCTION.....	1
Significance of the Study.....	2
Objectives of the Study.....	3
Time and Place of the Study.....	4
Scope and Limitation of the Study.....	4
Definition of Terms.....	5
REVIEW OF RELATED LITERATURE.....	7
MATERIALS AND METHODS.....	20
Materials.....	20
Originating Ground Station Circuit.....	20
Satellite Station Circuit.....	20
Destination Ground Station Circuit.....	21
Other Materials.....	21
Methods.....	22
Design Considerations.....	22

Design of Originating Ground Station Input Circuit.....	22
Design of Originating Ground Station Amplifier Circuit.....	25
Design of Originating Ground Station LED Driver Circuit.....	27
Design of Destination Ground Station Input Circuit.....	31
Design of Destination Ground Station Amplifier Circuit.....	32
Design of Destination Ground Station Output Circuit.....	33
Design of Satellite Station Circuit.....	35
Design of Satellite Station Receiver Circuit.....	35
Design of Satellite Station Transmitter Circuit.....	35
Construction of the Device.....	37
Description of the Device.....	37
Testing.....	40
Evaluation.....	40
Cost Computation.....	43
RESULTS AND DISCUSSION.....	50
Presentation and Analysis of the Design.....	50
Performance of the Device	52
Evaluation Result.....	54
Statistical Analysis.....	58
SUMMARY, CONCLUSION AND RECOMMENDATION.....	62
Summary.....	62
Conclusion.....	62
Recommendation.....	63

BIBLIOGRAPHY..... 64

APPENDICES..... 66

 Appendix A..... 67

 Appendix B..... 95

 Appendix C..... 98

 Appendix D..... 101

 Appendix E..... 104

 Appendix F..... 119

LIST OF FIGURES

Figure		Page
1	Schematic diagram of the Originating Ground Station (Transmitter).....	30
2	Schematic diagram of the Destination Ground Station (Receiver).....	34
3	Schematic diagram of the Satellite Station.....	36
4	Originating Ground Station (Transmitter) PCB Lay-out.....	38
5	Satellite Station PCB Lay-out.....	38
6	Destination Ground Station (Receiver) PCB Lay-out.....	38
7	Originating Ground Station (Transmitter) Components on the PCB.....	39
8	Satellite Station Components on the PCB.....	39
9	Destination Ground Station (Receiver) Components on the PCB.....	39
10	Block Diagram of the Satellite Communications Demonstrator.....	51
11	Block Diagrams of the Originating Ground Stations.....	53
12	Actual View of the Originating Ground Station (Transmitter) Circuit.....	53
13	Block Diagrams of the Satellite Stations.....	53
14	Actual View of the Satellite Station Circuit.....	53
15	Block Diagrams of the Destination Ground Stations.....	55
16	Actual View of the Destination Ground Station (Receiver) Circuit.....	55

LIST OF APPENDIX FIGURES

Appendix

Figure		Page
1	Input waveform with 1kHz input frequency and 1V input voltage.....	68
2	Satellite output waveform at 10cm distance.....	69
3	Receiver output waveform at 10cm distance.....	69
4	Satellite output waveform at 20cm distance.....	70
5	Receiver output waveform at 20cm distance.....	70
6	Satellite output waveform at 30cm distance.....	71
7	Receiver output waveform at 30cm distance.....	71
8	Satellite output waveform at 40cm distance.....	72
9	Receiver output waveform at 40cm distance.....	72
10	Satellite output waveform at 50cm distance.....	73
11	Receiver output waveform at 50cm distance.....	73
12	Satellite output waveform at 60cm distance.....	74
13	Receiver output waveform at 60cm distance.....	74
14	Satellite output waveform at 70cm distance.....	75
15	Receiver output waveform at 70cm distance.....	75
16	Satellite output waveform at 80cm distance.....	76
17	Receiver output waveform at 80cm distance.....	76
18	Satellite output waveform at 90cm distance.....	77
19	Receiver output waveform at 90cm distance.....	77

20	Satellite output waveform at 100cm distance.....	78
21	Receiver output waveform at 100cm distance.....	78
22	Satellite output waveform at 110cm distance.....	79
23	Receiver output waveform at 110cm distance.....	79
24	Satellite output waveform at 120cm distance.....	80
25	Receiver output waveform at 120cm distance.....	80
26	Satellite output waveform at 130cm distance.....	81
27	Receiver output waveform at 130cm distance.....	81
28	Satellite output waveform at 140cm distance.....	82
29	Receiver output waveform at 140cm distance.....	82
30	Satellite output waveform at 150cm distance.....	83
31	Receiver output waveform at 150cm distance.....	83
32	Satellite output waveform at 160cm distance.....	84
33	Receiver output waveform at 160cm distance.....	84
34	Satellite output waveform at 170cm distance.....	85
35	Receiver output waveform at 170cm distance.....	85
36	Satellite output waveform at 180cm distance.....	86
37	Receiver output waveform at 180cm distance.....	86
38	Satellite output waveform at 190cm distance.....	87
39	Receiver output waveform at 190cm distance.....	87
40	Satellite output waveform at 200cm distance.....	88
41	Receiver output waveform at 200cm distance.....	88
42	Satellite output waveform at 210cm distance.....	89

43	Receiver output waveform at 210cm distance.....	89
44	Satellite output waveform at 220cm distance.....	90
45	Receiver output waveform at 220cm distance.....	90
46	Satellite output waveform at 230cm distance.....	91
47	Receiver output waveform at 230cm distance.....	91
48	Satellite output waveform at 240cm distance.....	92
49	Receiver output waveform at 240cm distance.....	92
50	Satellite output waveform at 250cm distance.....	93
51	Receiver output waveform at 250cm distance.....	93
52	Transmitter Station Design from CES Industries.....	94
53	Satellite Station Design from CES Industries.....	94
54	Receiver Station Design from CES Industries.....	94

DESIGN AND CONSTRUCTION OF SATELLITE COMMUNICATIONS DEMONSTRATOR^{1/}

**Encabo, Rose Ann C.
Sumadsad, Alvin U.**

^{1/}An undergraduate design project submitted to the faculty of Department of Computer and Electronics Engineering, College of Engineering and Information Technology, Cavite State University, Indang, Cavite in partial fulfillment of the requirements for graduation with the degree of Bachelor of Science in Electronics and Communications Engineering with Contribution No. BSECE-2009-10-003. Prepared under the supervision of Engr. Michael T. Costa.

INTRODUCTION

Satellite is an object which has been placed into orbit by human endeavor. Such objects are sometimes called artificial satellites to distinguish them from natural satellites such as the Moon. Satellites are used for a large number of purposes. Common types include military (spy) and civilian Earth observation satellites, communication satellites, navigation satellites, weather satellites, and research satellites. Space stations and human spacecraft in orbit are also satellites. Satellite orbits vary greatly, depending on the purpose of the satellite, and are classified in a number of ways.

Satellite is one of the most helpful tools in communications. Satellite communications provide a microwave radio relay technology complementary to that of submarine communication cables. They are also used for mobile applications such as communications to ships, vehicles, planes and hand-held terminals, and for TV and radio