Environmental Effects On Electronic Circuits-A Simulation Study Performed Using MULTISIM

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ABSTRACT

Electronics is encountered in every day life in the form of telephones, radio, televisions, audio equipments, for industrial control and automation. Electronic product reliability is very important to both user and manufacturer. Designing products to survive harsh environments is expensive in time and money. An optimum design is one of that meets its requirements at minimum cost.

Different factors such as humidity, radiations, EMI, vibrations, shock, water leakage, fungal growth, chemical attack, damage due to abuse & many others would also play as distracter. In the industrial processes temperature is a main factor. Many of these factor factors will put constraints on the mechanical & electronic design. Electronic circuit design was verified by building prototypes, subjecting the circuit to various stimuli (such as input signals, temperature changes) & then measuring its performance by appropriate laboratory equipments.

Computer program that simulate the performance of an electronic circuit provide a simple, cost effective means of conforming the intended operation prior to circuit construction & of verifying new ideas that could lead to improve circuit performance. Today many companies' sale commercial simulator programs with added flexibility & features. Multisim is a powerful simulation tool that includes a complete, fully integrated, version of multicap for design entry leading to simulation. Multisim easily simulate analog, digital & mixed mode circuits. Multisim analyses provide you with an unrivaled ability to fully understand circuit behavior & performance.

This paper presents simulations of typically chosen representative circuit of analogue electronics. The circuit performance is tested by simulating under specified temperature range. The results are plotted as a function of temperature to show performance degradation of circuit operation. This study would then help the pool for bridging the gap between the customers need & the manufacturer which would cut down the product waste cost, time & efforts manufacturing new product.

Keywords: Environmental effects, temperature, MULTISIM.

1.1 Introduction:

Electronic products increasingly influence our daily lives. Consequences of their malfunction have a broad range, depending on the product type. Breakdown of common consumer goods, like household appliances audio\video systems, or home appliances, result in costly repair, irate customers and lost product reputation. Malfunction of business machines and computers cause costly down time. Telephone equipment failures not only affect our ability to communicate but also present a repair cost that eventually is passed on to the consumer by the telephone companies. Components and systems used by automotive industry and public transportation sector must have high reliability since they affect the safety of the user. Failures of systems used in the medical field for diagnostics

and therapy can human life in jeopardy. National defense, involving one of the largest users of electronics products, will be seriously affected by failures of electronic products. Malfunction can mean loss of human life, a mission, or of vital information. Failures of defense products also place a heavy burden on our national budget and dilute the defense dollar. Hence product reliability is very important to both user and manufacturer [1].

Designing products to survive harsh environments is expensive in time and money. Care and attention in the design and development phase is essential if all environmental characteristics are to be addressed whilst not over designing the product. An optimum design is one of that meets its requirements at minimum cost. Designing any new electronic product is core aspects of the engineering discipline. The physical environment is the environment within which the piece of equipment or system that is being designed and developed is expected to operate. But sudden change in the physical environment say temperature to +20 will disturb the working of circuit components and system. It will be resulting into a lot of heat dissipation from some components, which in turn force other neighboring components to deviates and produce undesired effects leading to occasional failures.

Another common example of physical environment is in electronics industry where the instruments operating temperature range is expected to be from -55 C to +125C over which the equipment is required to function to its required specification. When such instruments are installed in controlled panel or near the heating furnace surface, most of the time it is observed that circuits are malfunctioning & do not produced the intended readings & the system may be fail due to over heating of components during the operation.

Other factors such as humidity, radiations, EMI, vibrations ,shock, water leakage, fungal growth, chemical attack, damage due to abuse & many others would also play as distracter. Many of these factor factors will put constraints on the mechanical& electronic design. This all may not always be put in same direction. The final design is lightly to be a compromise that produces a design that is adequate for the purpose.

Traditionally, electronic circuit design was verified by building prototypes, subjecting the circuit to various stimuli (such as input signals, temperature changes) & then measuring its performance by appropriate laboratory equipments.

Computer program that stimulate the performance of an electronic circuit provide a simple, cost effective means of conforming the intended operation prior to circuit construction & of verifying new ideas that could lead to improve circuit performance. Such computer programs have revolutionized the electronic industry leading to the development of electronic circuits. The use of computer aided design tools has proven to be invaluable in the development of new technologies & circuit design [2].

Using a computer to stimulate the behavior of an electrical or electronic circuit has both advantages & disadvantages conventional method. Today many companies' sale commercial simulator programs with added flexibility & features. Multisim is a powerful simulation tool that includes a complete, fully integrated, version of multicap for design entry leading to simulation. Multisim easily simulate analog, digital & mixed mode circuits. Multisim analyses provide you with an unrivaled ability to fully understand circuit behavior & performance.

1.2 Temperature Analysis Using Multisim

Multisim offers you many analyses, all of which use simulation to generate the data for the analysis you want to perform. These analyses can range from quite basic to extremely sophisticated, and can often require one analysis to be performed (automatically) as part of another. For each analysis, you will need to decide upon some settings that will tell Multisim what you want the analysis to do. In addition to the analyses provided by Multisim, you can also create user-defined analyses based on SPICE commands you enter. When you activate an analysis, the results are displayed on a plot in the Multisim Grapher, unless you specify otherwise, and saved for use in the Postprocessor [3] [4]. To indicate that an analysis is running, the Simulation Running Indicator appears in the status bar. This indicator flashes until the analysis is complete. Following section shows temperature analysis for full wave rectifier over a temperature range 10-100^{0}C.

1.3 Experimental Results for FULL WAVE RECTIFIER:

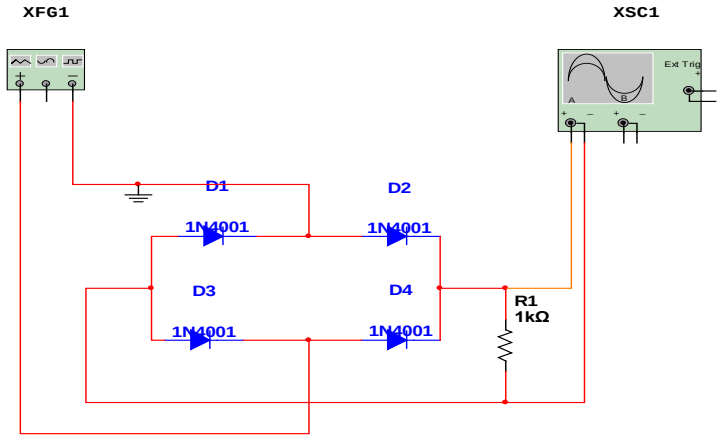


FIG 1. CIRCUIT DIAGRAM OF FULL WAVE RECTIFIER

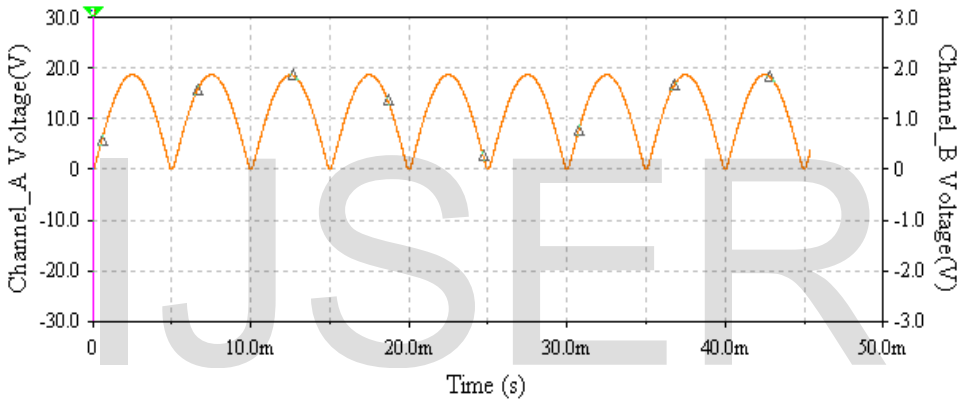
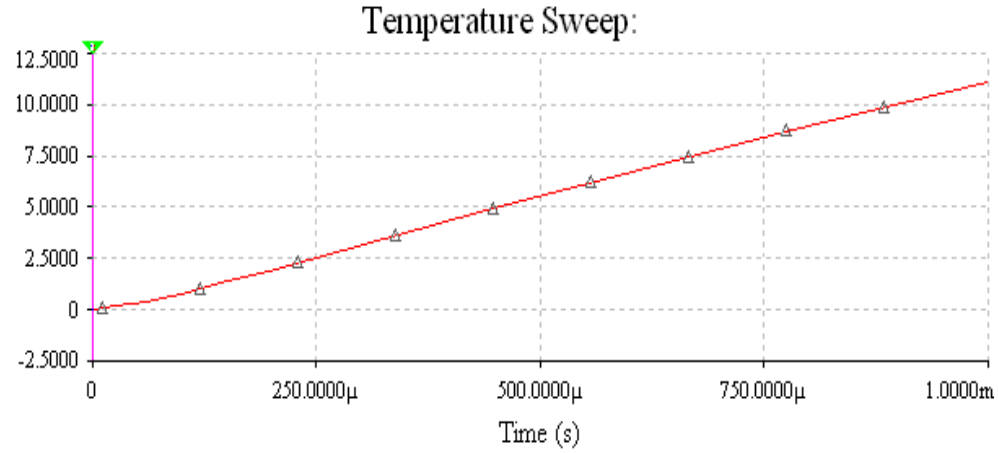


FIG.2 OUTPUT WAVEFORM

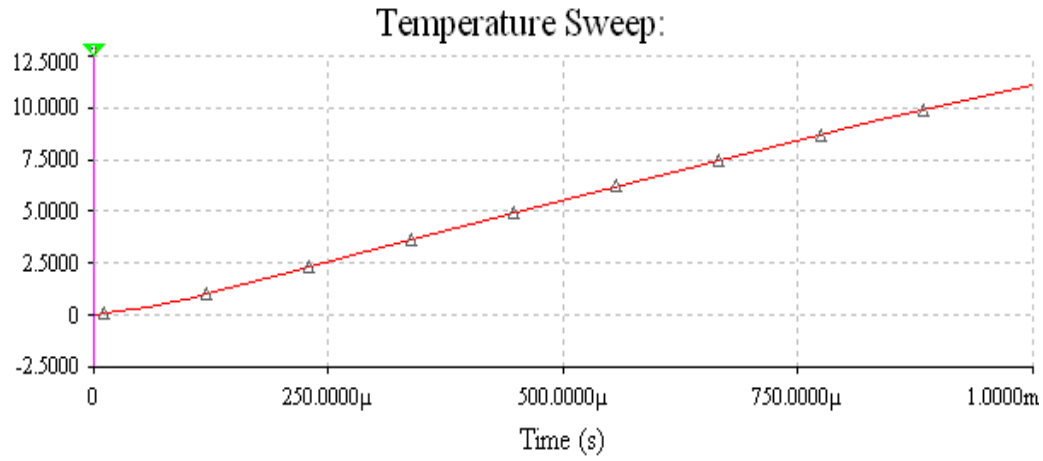
Maximum Voltage = 18.6250 volts

1. Temperature 10 ^{0}C:



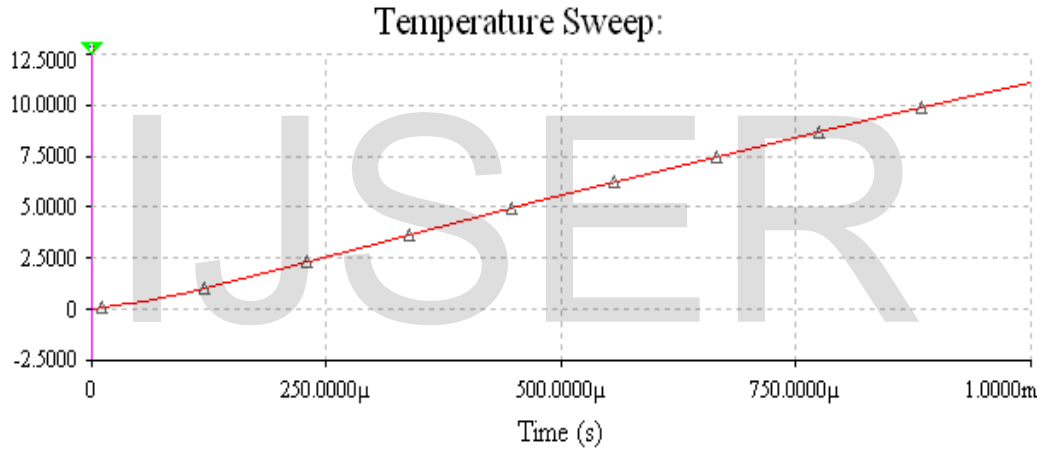
Maximum Voltage = 11.0905 volts

2. Temperature 20 ^{0}C:



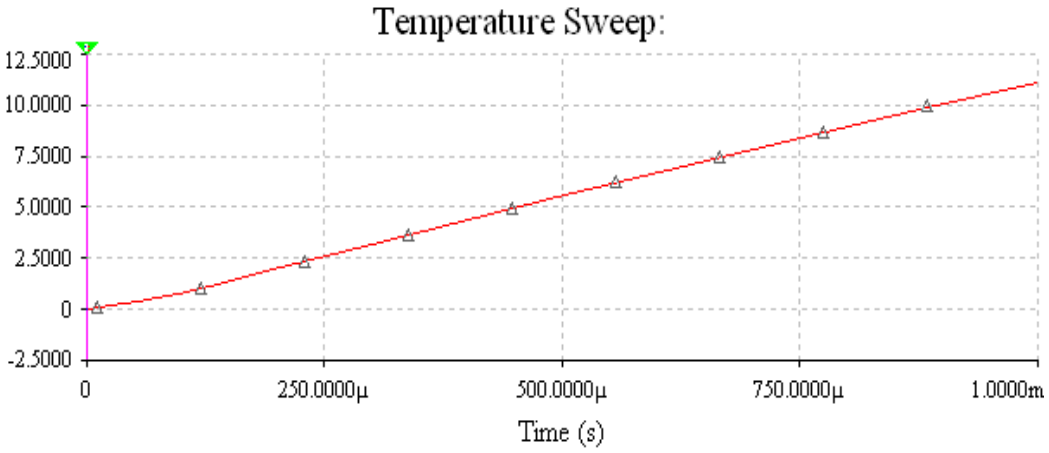
Maximum Voltage = 11.0954 volts

3. Temperature 30 ^{0}C:



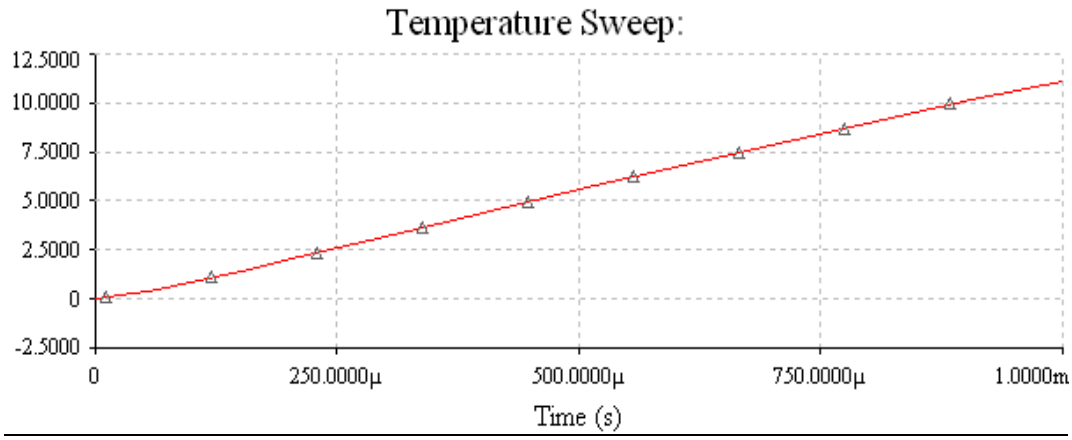
Maximum Voltage = 11.1001 volts

4. Temperature 40 ^{0}C:



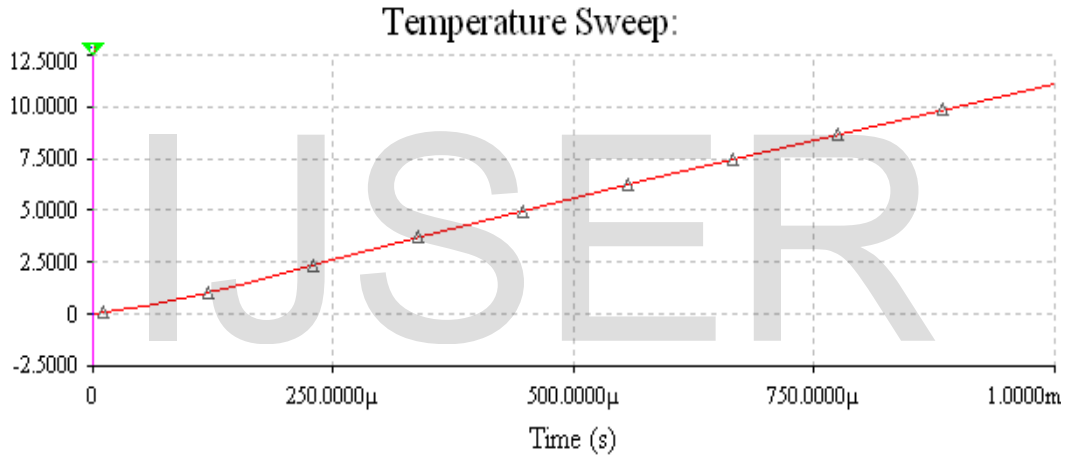
Maximum Voltage = 11.1049 volts

5. Temperature 50 ^{0}C:



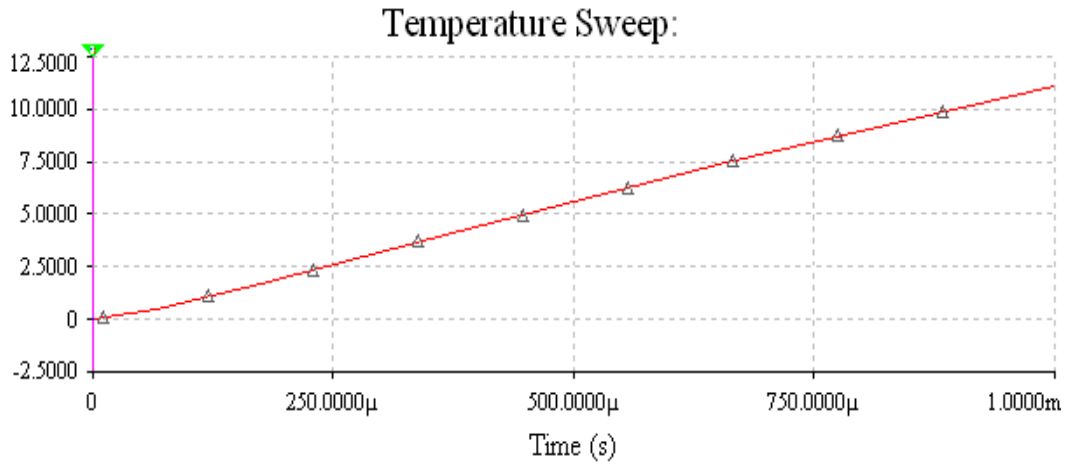
Maximum Voltage = 11.1095 volts

6. Temperature 60 ^{0}C:



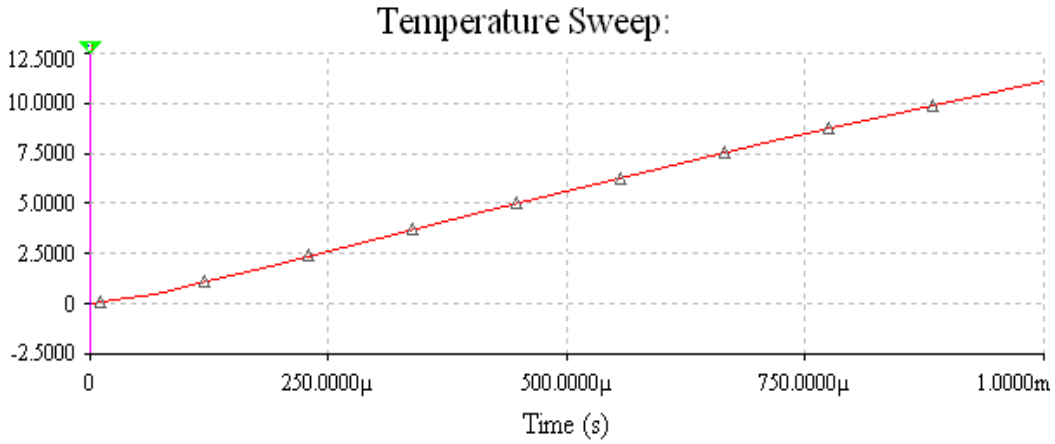
Maximum Voltage = 11.1138 volts

7. Temperature 70 ^{0}C:



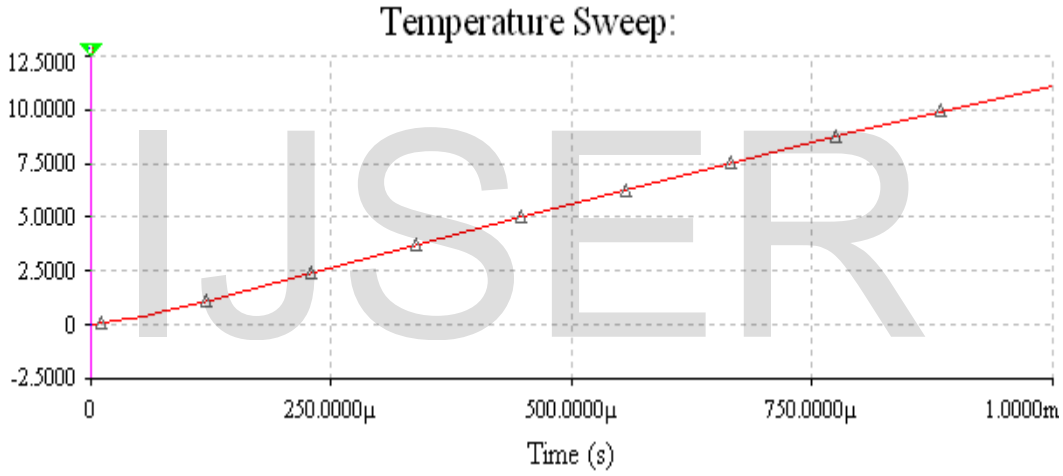
Maximum Voltage = 11.1189 volts

8. Temperature 80 ^{0}C:



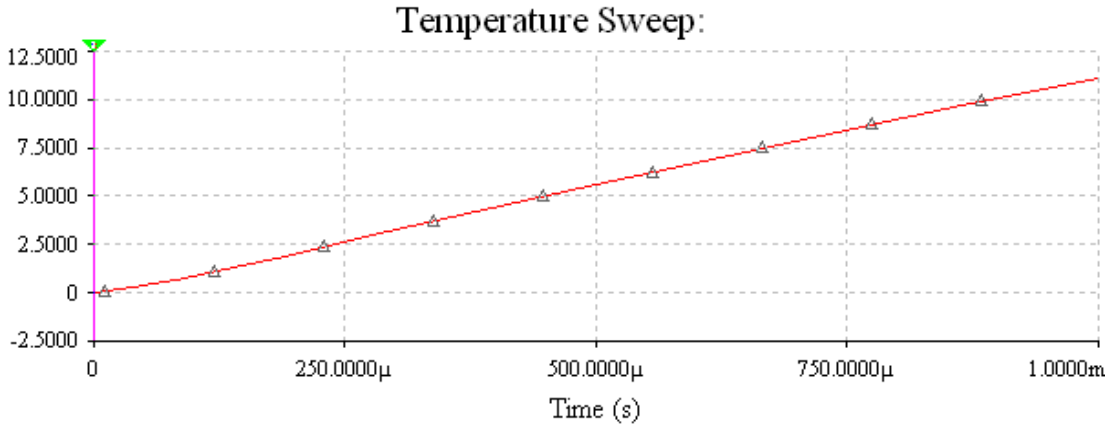
Maximum Voltage = 11.1237 volts

9. Temperature 90 ^{0}C:



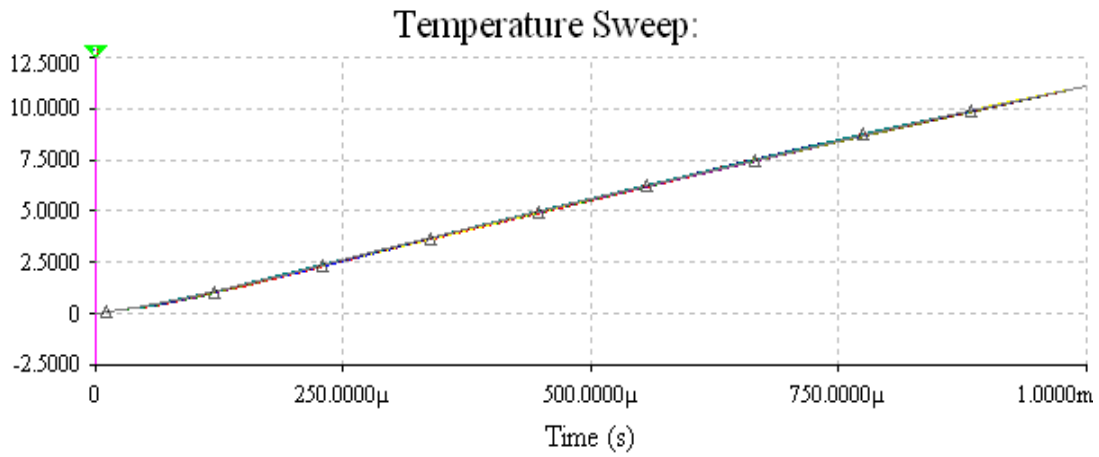
Maximum Voltage = 11.1284 volts

10. Temperature 100 ^{0}C:



Maximum Voltage = 11.1329 volts

11. OUTPUT WAVEFORM FOR 10-100^{0}C :



1.4 Conclusion:

The aim of present work is to study temperature effect on full wave rectifier as one of the environmental effects on circuit performance using MULTISIM. Specifically temperature effect is first choice due to availability of the direct facility in MULTISIM. The temperature analysis over temperature range 10-100^{0}C shows that as temperature increases the output voltage also increases. One can use temperature compensating circuit to overcome this effect.

1.5 Referances:

1. S. B. DEORE, R.R.SALVE, A. B. KAPSE & A. V. MANCHARKAR, "Student / Demo version of Electrical & Electronic Simulation Software Comparison–A review", State Level Conference on Optical Fiber Communication & Sensor Application (OFCS-2008), New Arts, Commerce & Science College Ahmednagar, 22nd to 24th December 2008.

2. S. B. DEORE, R.R.SALVE, A. B. KAPSE & A. V. MANCHARKAR, "COMPARATIVE STUDY OF VARIOUS CIRCUIT SIMULATION SOFTWARES" Presented in Project Exhibition. 14th Feb 2009 held in Poona College, PUNE

3. M. H. Rashid, SPICE For Circuits And Electronics Using PSPICE Prentice Hall of India, Second Edition, 2004.

4. Multisim from http://www.ni.com/multisim/