MAT JOURNALS

Journal of Switching Hub
Volume 2 Issue 3

Optimization of Heating Tissue through High Frequency Electrotherapy

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Abstract
We have developed associate natural philosophy circuit that generates a high voltage with a frequency of 0.3–a pair of MHz to create associate electrotherapy system which will optimize tissue heating characteristics. These characteristics area unit employed in medical applications. This paper is concentrated on the analysis of high frequency electro-therapy system to optimize tissue heating with the assistance of a high voltage pulse signal, that peak voltage is nearly 2kV. This optimized tissue heating between the inner tissue and also the thermal distributions has examined in terms of frequency and voltage. The target tissue heating consists of one conductor in associate experiment that has particularly conducted to seek out the tissue heating characteristics. In the end, a replacement methodology for electro-therapy is developed, that is applicable to a particular tissue depth.

Keywords: *High voltage, frequency, electro-therapy, LLLT*

INTRODUCTION

The improvement of our quality life makes us additional targeted on health care and body treatment [1, 2]. Recently, additional attention has been paid on the way to develop innovative tending machines and sweetness instruments [3, 4]. Electricity treatment machines are wide utilized in numerous fields in medical treatment like pain management, neuro musculardys operate, tissue repair etc. This machinery serving to U.S.A. to urge psychological satisfaction that and also the system is powerful enough to preclude the injurious diseases. A vicinity from the electricity medical aid, alternative technologies like optical maser medical aid, ultrasound medical aid, and magnetic force medical aid are wide deployed for bio-medical applications. A randomised, double-blind, placebo-controlled study of low- level optical maser medical aid (c) in ninety subjects with chronic neck pain was conducted with the aim of determinant the effectualness of 300mW and 830nm optical maser within the management of chronic neck pain. The optical maser medical aid may peel the skin off the body with optical maser and chemicals, thus it caused injury to the skin – healing of those wounds may take weeks. Therapeutic ultrasound has been extensively wont to treat a range of conditions as a result of its documented thermal effects. It's repeatedly been shown to extend tissue temperature at depths up to 5cm with solely stripped will increase in skin temperature. It's been advised that a rise of 181C (mild heating) over baseline muscle temperatures of 36.81C to37.81C accelerates the rate in tissue. A rise of 2.81C to3.81C (moderate heating) reduces muscle spasms, pain, and chronic inflammation and will increase blood flow. Vigorous heating, metropolis increase of 4.81C or additional, has been advised to altert heviscoelastic properties of albuminoid and inhibit sympathetic activity.Because of baseline temperature variations between people, however, it should be higher to talk of the thermal effects of therapeutic ultra-sound as occurring at specific absolute tissue

temperatures instead of relative changes from baseline temperatures. As an example, several of the authors, who performed the first work on thermal effects, delineate the specified physiological effects as occurring at an absolute tissue temperature more than 39.681C. In spite of whether or not we have a tendency to discuss absolute or relative temperature changes, manufacturing a therapeutic increase in tissue temperature needs careful attention to the particular ultrasound settings being employed. Disadvantages of ultra-sound powering implants embrace the requirement for physical coupling of the ultrasound to the body surface and in some cases the requirement to accurately maintain the electrical device position on the skin counting on the need. Magnetic force medical aid has been used with rumored success in multiple clinical settings, as well as the treatment of seizure disorders, brain dropsy, hemicrania headaches, revascularization of burn wounds and diabetic ulcers. A randomised, prospective, double-blind, placebo-controlled pilot study was conducted to guage the effectiveness of high frequency periodical magnetic force energy victimization the di-pulse device within the treatment of chronic symptom. The unit was set to deliver magnetic force energy at a frequency of 27.12 mhz at a repetition rate of 600 pulse per second. On the opposite hand, the term electrotherapy will apply to a range of treatments in medical field, together with the utilization of electrical devices like deep brain stimulators for disorder. The term has conjointly been applied specifically to the utilization of electrical current to hurry healing wounds. To boot, the term "electrotherapy" or "electromagnetic therapy" has conjointly been applied to rearrange of different medical devices and coverings. Electro-therapy provides safe treatment to patients. High frequency high voltage wattage is generated and controlled by the well- developed power physics technology, therefore we tend to are ready to manufacture an electro-therapy system with sensible stability and potency. It will deliver terribly safe treatment. From the review, we are able to perceive that every and each medical aid treatment has its own characteristics. Because the totally different characteristics vary, it has to adapt management for various sorts of body components. In medical applications, the ways in which of approach to medical aid treatment are totally different for various therapies and every one of the mgivereasonable results and build this treatment additional thinkable. The character of the body conjointly varies from person to person, therefore we tend to are involved with those difficulties to create an electro medical aid system to attain the meant goal for medical treatment. An electro medical aid system includes a high vary of kv and high frequency which needs nice stability and responsibleness to be used in medical treatment. Therefore, the event of the high frequency electro-therapy machines might modification the output frequency of electro-therapy to stop the potential harm of the body. Throughout the event of the high frequency electro- medical aid, we tend to monitored the signal and analyzed however it had been varied with relation to the applied frequency. We tend to work out that explicit frequency in our information measure achieves the utmost remedial price. We tend to found that electrotherapy offers an affordable output for various frequencies. So, it's helpful for additional bio-medical treatments once it operates at totally different frequencies. Victimization power physics technology, governable high voltage high frequency is designed and operate the electro medical aid machine towards medical specialty applications [5–8]. To heat the tissues victimization by electro medical aid system, we want to regulate and control the applied power of high voltage high

frequency. Different vital concern in medical treatment is safety of patients, we should always additional concern on circuits that control and dominant the high voltages properly. Moreover, the temperature management for the native tissues needs to be studied at the same time. The analysis needs to be administered with the frequency wave kind and voltage variations.

System Design

Circuit Design

The revered supply component should be operated by governable high voltage high frequency signal to create electro medical aid system. The circuit shown within the below figure, is meant to come up with HVHF. The designed circuit will operate at a frequency between 500kHz and 2MHz and a voltage of two kilovolt. This circuit style includes a DC-DC switched mode power provides, associate AC to DC device and management circuits. The HVHF system adopts a hybrid modulation technique to manage the high frequency output pulses. In medical applications, the load ought to be an organic chemistry material that isn't like several alternative electrical load, thus most offered regular voltage management strategies, that square measure in the main designed for electrical load applications, aren't fitted to this type of medical specialty application. Especially, the device desires quick speed of response as a result of safety issues, so constant voltage and constant current (CVCC) management was designed specially in keeping with suit this application. Fig.1 shows that one section 220V common AC with associate adapting PFC (power issue control) has been taken as a supply. The characteristics of input power square measure improved to a high power issue and low harmonics. An LLC resonant device is employed to convert to a coffee DC voltage provide.

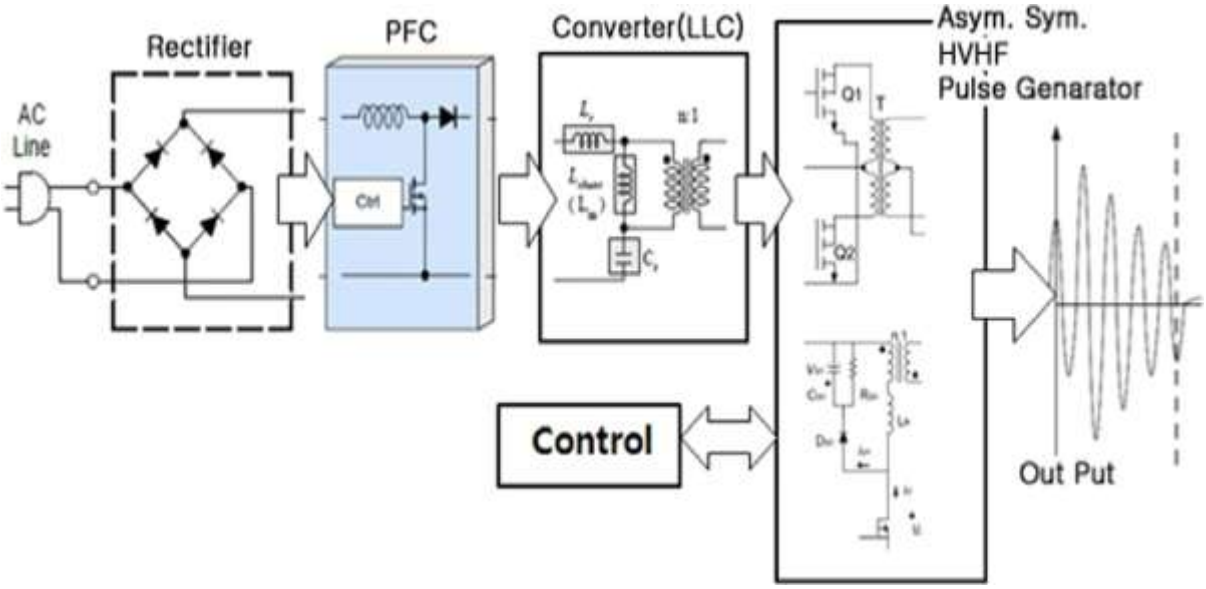

***Fig. 1** Block Diagram of HVHF System*

High voltage high frequency (HVHF) generator

Fig. 2 shows the schematic illustration of HVHF generator. It's 3 main characteristics: frequency, wave form and duty cycle. The circuit is meant with a fly-back topology. The vary of driving frequency is variable from 300 kilocycle per second to 2.0MHz and therefore the duty cycle of this device is additionally adjustable. For circuit style, victimisation UC3844, the circuit structure is modified

and applied for every topology to cut back the value that is spent to create the driving system. Then, an output is controlled by the additional MCU.

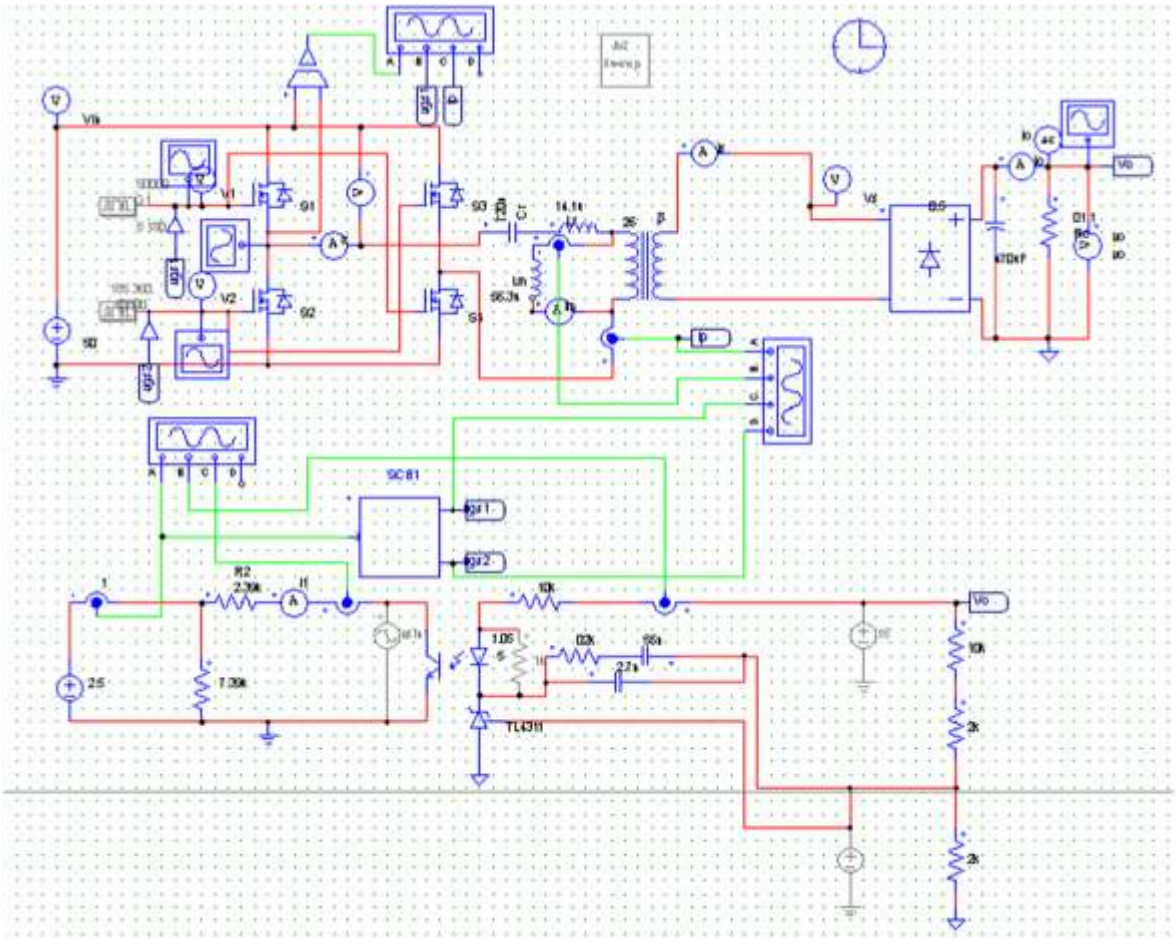

***Fig. 2** Schematic Circuit for Simulation Test.*

CONTROLLER

The management half in the main focuses on the observation show that is controlled by ATmega128 microcontroller with simple pulse control. This management circuit's hardware style, that could be a combination of the ATmega128 microcontroller, a diode show and few a lot of switches. The characteristics of the projected system includes a high frequency (4100 Hz) of basic wave output mixed with low frequency (o10 Hz) of low frequency part. This system isn't acceptable for the system that encompasses a quick interval like an influence transfer system, however it's terribly cheap for adapting to tissue load that encompasses a slow interval.

Power supply

The power consumption rate of this device is concerning 100W whereas a high voltage pulse is applied to the target tissue. we have a tendency to designed the facility provide that able to handle 200W power, 12–15 Vdc,13Ad crating, and LLC resonant device topology that is generally used for medium capability AC-DC converters.

The resonant inductance L and resonant electrical device Crarein series. The resonant tank is asynchronous with the load. From this configuration, the resonant tank and also the load act as a potential divider. By dynamical the frequency of input voltage Va, the ohmic resistance of

the resonant tank can amendment. This ohmic resistance can divide the input voltage with the load. Since it's a potential divider, the DC gain at SRC is usually not up to one. At resonant frequency, the ohmic resistance of the series resonant tank are going to be terribly small; all the input voltage can drop on the load. Thus, for the series resonant device, the utmost gain happens at the resonant frequency. Also, the applied power issue and doctorate (third harmonic distortion) of this circuit operate at an affordable level and improve the facility issue employing a sub boost circuit to an honest level. We have a tendency to area unit greatly involved concerning power provide style for operational a medical specialty device. Constant voltage constant current feedback loop that controls the facility provide to urge as table high voltage output and provides over current protection. So as to urge constant current and constant voltage within the circuit, FSFR2100 with over current opposition was used and conjointly a special feedback loop was other.

The EMC protection

The noise pattern of this device is generated by the high frequency shift with dominant harmonic noise part of the elemental wave. Also, high frequency static is formed by the high voltage field of force of the inner device. As a result of this, with traditional noise protection, a PCB pattern and noise current come back path of the input and output aspect got to be thought-about. Although there area unit several theoretical suggestions for noise protection however there also are several complicated things to be thought-about like circuit pattern, array of parts and internal interferences. Therefore, it's terribly troublesome to handle these issues expeditiously. Therefore, the empirical experiences area unit rather more vital. Normally, reducing the harmonic noise part has several issues. Therefore a twin filter structure is applied for noise protection between the lines. Therefore the basic device and inner aspect of the device area unit protected by coupling of the noise between the within elements. Also, within the case of the output aspect conductor, the radio wave is shipped to ground. Thanks to the inner elements of the electronic circuits and therefore the PCB board, the sign contains plenty of noise. This noise cannot be simply eliminated. Thus we have a tendency to calibrate the sign here and find an affordable output which may be used for analyzing the results.

Optimal temperature for palm tissue treatment

A temperature sensing element is employed to stimulate palm tissues. The insulated conductor transferring heat to the deep tissue is combined with slightly sensing element. Once the conductor surface presses the palm tissue, the bit sensing element operates along, and also the bit sensing element sends a symbol to the system.

CONCLUSION

This study presents the primary result for the palm tissue heating characteristics victimization electro medical care round the one.5 MHz band. Additionally, the characteristics of atmospheric static and transferring path rechecked, so a technique for determination noise issues is investigated. It's clear that this high frequency heating methodology will be used for activity diseases like numerous pain releases. It's potential to penetrate the warmth within the deep tissues with precise management. The deep tissue heating around 1.5MHzis completely different from that of below1MHz.The heat distribution and diffusion characteristics area unit completely different from the applied frequency. Within the future work, a lot of experiments are dispensed on those who

area unit in numerous age teams and suffer chronic pain on back and joints.

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