iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** X **Month of publication:** October 2020

DOI: https://doi.org/10.22214/ijraset.2020.31973

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue X Oct 2020- Available at www.ijraset.com

Detection of Holidays on a coating Surface using Microcontroller

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Abstract: ***A holiday detector is a device used to inspect nonmoving equipment or a metallic surface to ensure structural integrity and assist with corrosion prevention efforts. Holiday detectors are commonly used to resolve the rate of premature coating failures on a metallic surface by sensing the presence of coating faults and discontinuities (holidays) and the porosity of the coating.Holiday detectors are used to inspect pipelines, operational plant equipment and other metal surfaces by being manually moved along the surface being going to under test. They are used to keep out properties such as protective coating thickness, cracks, and salt and moisture present in environments as concentration. In commercial plant or factory consisting coating methods for the application of a layer of respective material consider to a substrate, like paper, fabric film, foil, plastic, or sheet stock , PVC material..***

Keywords: Fly back transformer, ferrite core, flybak driver circuit, voltage multiplier circuit, high power transistor, control circuit, sensing circuit.

I. INTRODUCTION

Holiday Detector is capable to detect any discontinuities or pinholes in anticorrosive coating on metallic pipes/surfaces. The pipe is connected to earth and electrode charged to high voltage is moved over coating. If any voids or faulty point is located bt detector on coating, high voltage spark generated on pipe or surface of testing. Holiday detection equipment is safer, faster and more reliable than ever before. There are different types of holiday detectors on the market today, but high voltage holiday tests, or porosity techniques, is better for testing pipelines and other protective coatings.

The Holiday Detector is a Multi-purpose electrical inspection device which control's a given inspection voltage despite the electrical load on the circuit, this is also called as DC pulse holiday detection. These

Specific model supplies 800V to 35kV in one device with two various ranges from 3,500V to 35,000V and a low voltage range of 800V to 8,000V. There is some standard notation for use on any pipe diameter as well as on flat surfaces.

There are two main types of holiday detectors:

1) *High Voltage Detectors:* Used to inspect the pipe having thick surfaces
2) *Wet Sponge Detectors:* Used to inspect the pipe having thin surfaces

Holiday detector, high-voltage, is a device used to find the voids or holidays in coatings thicker than 500 microns (20 mils). It specially contains of a power source, a EHT wire, a probing electrode and an indicator. The indicator is a light or audio that is on when a holiday is detected.

There are mainly two types of high-voltage holiday detectors: the pulsating direct current or the continuous direct current. The pulsating direct current holiday detector is the prefer commonly used type.

A pulsating direct current coming from high voltage holiday detector discharges the adjustable or regulated high voltage while cycling. It is used for use in dirty, damp, contaminated or slightly conductive coating surfaces. For inspection or testing of holidays on non-conducting surfaces like pipelines storage tanks & valves a continuous direct current type holiday detector is used. This continuous DC current also discharges high voltage.

A. A wet Cellulose Sponge Holiday Detector

This connected to the inspection electrode of a low voltage holiday detector wet sponge type device. During the test, as the inspection electrode moves over the surface of pipe where coating is done, moisture from the wet sponge penetrates any voids or pinholes or holidays in the coating and makes a conductive path with respect to the substrate. Then, depending on the design construction, the holiday detector signals that a defect in a coating was found either through an alarm or a flashing LED as indicator (usually Yellow).A identified holiday location is marked for repair before further testing.

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II. SYSTEM DIAGRAM

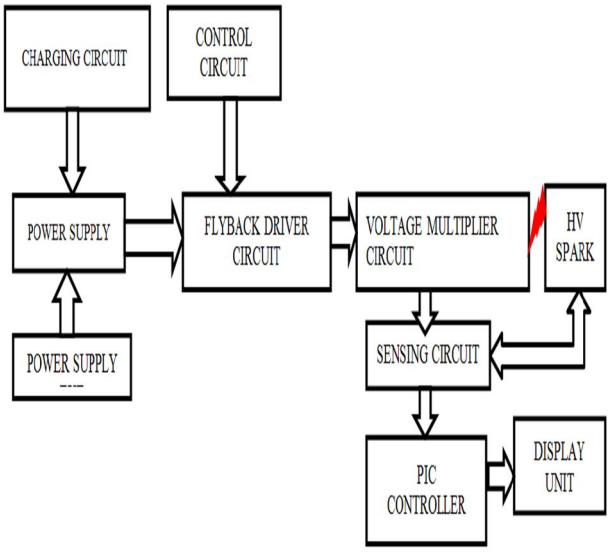

Fig-1: System Block Diagram For Holiday Detector

III. HARDWARE SPECIFICATIONS

A. Fly Back Transformer

A fly back transformer is a coupled inductor with a gapped core. As input is applied to the primary side of the transformer the electrical energy stored in air gap of core. It is then induces to the secondary winding to provide charge to the load. Fly back transformers are used to provide voltage conversions and circuit isolation in fly back converters.

The fly back transformer is choice for cost effective& high efficiency isolated power having power around 120watt. They supply circuit with isolation, the power for multiple outputs and therefore the possibility of positive or negative output voltages. This affect in reduces the component count and simplifies the circuit requirements.

This discusses fly back transformers and applications that they're best suited.

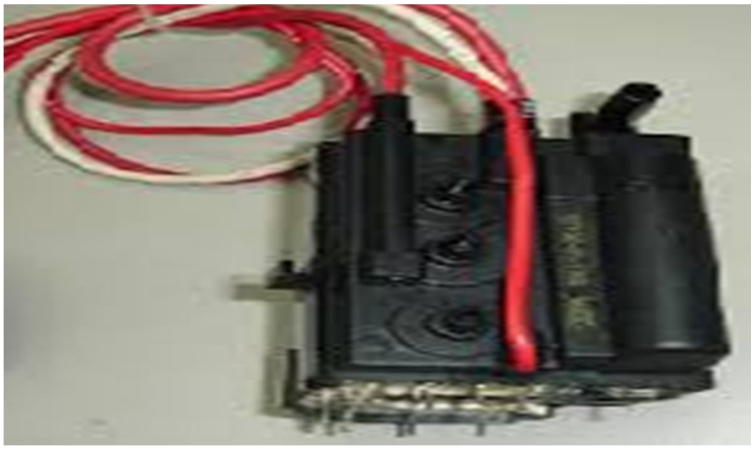

Fig.2 Actual fly back transformer

What is fly back?

In the fly back concepts, energy is stored within the style of field of the transformer during the primary 1/2 the switching cycle of transistor then induced to the secondary winding(s) connected to the load. The most features of Fly back transformers could be a gapped-core construction, which allows high energy storage without saturating the core. During this flybck transformer the stored energy consists of forward-mode where energy transfers immediately from primary to secondary.

Fly back transformers are called as coupled inductor, because they need a gapped core construction and store energy within the core.

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B. Ferrite Core

Ferrites are ceramic compounds of the transition metals with oxygen, which are ferromagnetic but nonconductive. Ferrites that are employed in transformer or electromagnetic cores contain iron oxides combined with nickel, zinc, and/or manganese compounds. They need a coffee coercively and are called "soft ferrites" to differentiate them from "hard ferrites", which have a high coercively and are wont to make ferrite magnets. The low coercively means the material's magnetization can easily reverse direction with dissipating very less energy (hysteresis losses), while the material's high resistivity prevents eddy currents within the core, another source of energy loss.

Fig3.Ferrite core

C. Fly back Driver Circuit

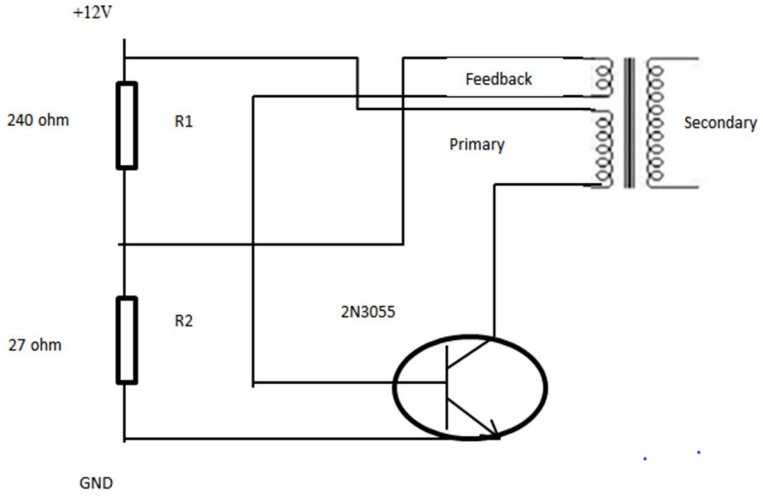

Fig. 4 Fly back Driver circuit

This is probably the foremost well-known fly back transformer driver circuit. It uses two 2N3055 power transistors during a push-pull oscillator configuration.

The worth of the resistors isn't that critical. after all you'll even use a 1/2W for the 27 ohm resistor, but it should break if it's left to last an extended time. This circuit will accept voltages up to about 24V, but i might not go any above this as you risk destroying the fly back transformer. Also it shouldn't have a rectifier in-built. The rectifier decreases the performance of this circuit greatly since it cuts off the opposite cycle. One mustn't run this on any power supply which is pricey. this can be because the circuit will produce many feedback and might destroy sensitive components in an exceedingly decent linear or switching power supply. If you are doing run it on a decent power supply take care to place an oversized filter capacitor across the input of this circuit. A choke is additionally recommended. At the side of primary two sorts of winding primary & feedback having turns 8 & 4 respectively. The secondary consists more turns than primary side. But we are able to use two 2n3055 transistors one is for switching action& another is for set voltage using 1k potentiometer. In fig4 only fly back driver circuit using one transistor is shown. The 2 transistors are linked with conductor for warmth safety purpose.

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D. Control & Sensing Circuit

The feedback loop is employed mainly for to manage the entire operation of holiday detector. It mainly consists of comparator IC, buzzer circuitry & sensitivity section. The working operation of this circuit is that as per our pipe thickness 1st we've got to line voltage generally 10kv is chosen as during this circuit. As per set voltage adjust sensitivity .The sensitivity circuit consists of 10k potentiometer for adjustments. Here the connection is completed so as if sensitivity level is above reference level Buzzer is on.

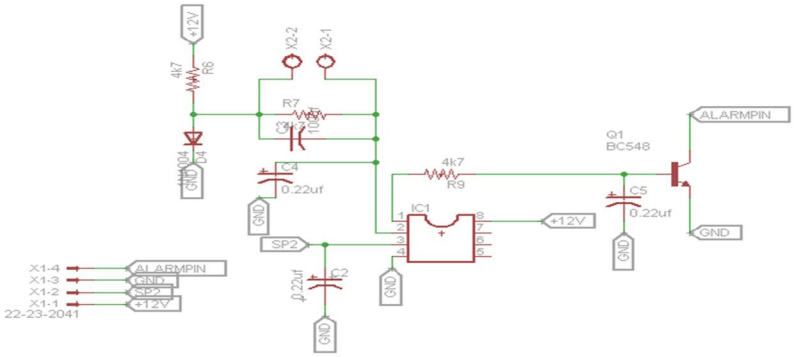

Fig.5 Control & sensing circuits

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E. Voltage Multiplier Circuit/HV Filter/HV Rectifiers

This is a voltage multiplier circuit or HV filter circuit. It's also called as high voltage half wave rectifier. When power is on we will set voltage level from potentiometer. At the complete turn of potentiometer the input voltage from primary side of transformer is induced within the secondary. The output coming at the secondary of fly back transformer& it's around 10kv Ac is given to the input to the HV rectifier. This HV rectifier consists of 1 16 kv diode having current rating 300ma, & bank of capacitor having rating 4.7nf , 2kv.This two KV 8 capacitor is connected in an exceedingly such manner that its filter all HV voltage. This is circuit is an HV half wave rectifier.

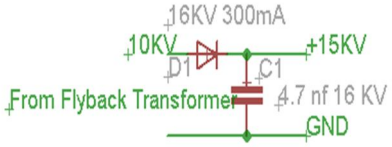

Fig.6 Voltage multiplier Circuit

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The output is that this circuit isn't purely dc it's a Pulsating DC. The charging & discharging period of this capacitor during this action is incredibly fast. But some drawback is during this circuit is voltage loss. The output of this circuit is around 15kv. The caution taken in this circuit that connect all components properly & insulation between them is proper. This HV is given to the electrode for inspection of pipe. This gives rms value of input.

F. PIC Controller & Display Unit

This unit is related to display the set voltage level to the observer. It consists of mainly 4 Digit seven segment displays & PIC microcontroller circuitry with power supply.In this display unit a high voltage coming from multiplier circuit is read out by this PIC microcontroller using some circuitry & displays the voltage in KV.

The unit also displays value in decimal i.e. 5.7kv, 8.3kv …..The PIC microcontroller is coded with Embedded C programming languages. Only one drawback is when spark is occurring the display unit shows 0 values. Also here the observer can set set the or adjust voltage level as per pipe size or require level while looking towards the display unit.

G. Power Supply

The total power supply is given to this device is given from battery having rating 12VDC, 9A.It is dry rechargeable battery. This gives power to fly back transformer primary side, control unit, display unit, sensing unit. The recharging facility is also provided to the battery with charging circuit.

IV. SOFTWARE IMPLEMENTATION

1) *IDE:* MPLAB IDE v8.87- The MP Lab could be a free ware IDE for developing the embedded system programming associated with PIC. This software uses an Embedded C programming languages. Here during this device we use this IDE for developing the code for read & Display voltage.
2) *PIC KIT 3:* It interfaces the IDE with IC. The MPLAB PIC kit three acknowledges to debugging & programming of PIC & dsPIC microcontroller at most cheap value purpose victimization the powerful graphical computer programmer of the MPLAB IDE
3) *Eagle Version 6.1.0:* It is design software used for design of electronics circuit & for generating PCB layout. It is also GUI.

V. WORK FLOW OF SYSTEM

At initially stage the power supply is on with blown yellow LED. After Pipe selection as pipe coating thickness set the voltage as required level. At initially stage the power supply is on with blown yellow LED. After Pipe selection as pipe coating thickness set the voltage as required level.

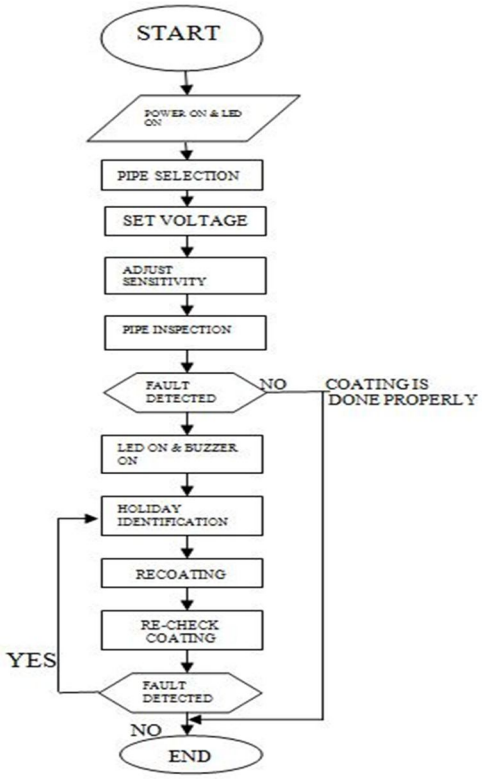

Fig8: Flow Chart of work

At initially stage the power supply is on with blown yellow LED. After Pipe selection as pipe coating thickness set the voltage as required level. Adjust the sensitivity as per the set voltage using buzzer sound. After completing all steps do the inspection of pipe while moving the electrode in the coating surface. If any discontinuity, pinhole, voids or holiday present fault is detected buzzer on with red LED blown. If fault is not detected coating is done properly no holiday present in the coating. After fault detection identify the holidays & mark there places.

After marking this all recoating the pipe surface. At last check repeat pipe surface if holiday detected repeat the process if not then end the fault detection process.

A. Operating Instruction

1) Turn SENSITIVITY & SET VOLTAGE knobs anti-clockwise.
2) Put ON the device using switch
3) Adjust output test voltage to desired test voltage
4) Rotate SENSITIVITY knob to clockwise to start buzzer. Now device is ready to use.

VI. OBSERVATIONS, RESULTS & DISCUSSION

A. Observations

Recommended voltages rang for holiday tests**

COATING THICKNESS	HOLIDAY DETECTOR VOLTAGE IN VOLTS
0.25MM	750
0.50MM	1600
1.00MM	3000
2.00MM	5800
2.25MM	7100
3.00MM	9500
3.75MM	12000
4.25MM	13300
5.00MM	16000

B. Results

Testing with plate electrode on coating surface

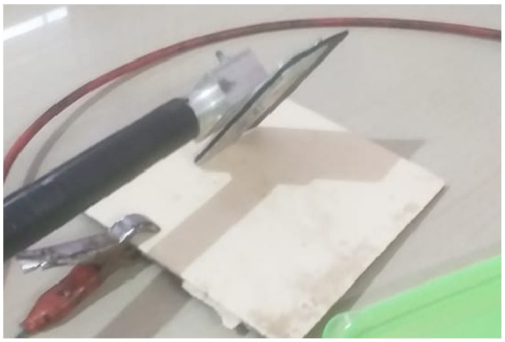

Fig9: No holidays are present on the surface

In fig 8 it's clear that there is no holiday present on the surface where coating is done. No high voltage spark is generated while inspecting. It's clear that coating is done properly.

Fig10. Holiday present on the surface where coating is done.

From fig 9 it is clear that while doing inspection the holidays are present on the surface where coating is done. Due to this holiday HV spark is generated as shown in figure9.So after identification & marking the exact location of holiday & recoating the surface repeat.

C. Discussions

1) Advantages

a) Simple
b) Accurate
c) Durable
d) Versatile
e) Safe
f) Powerful
g) Adjustable & visual holiday indicator
h) Digital Actual Set voltage Display(4digit)

2) Applications

a) To Test electrical insulate coating like coal tar, paint, polyurethane, asphalt, PVC, glass, resin coating etc.
b) Used to underground cable fault detection using some extra circuitry.

3) Future Scope

a) An 30KV Output Detector
b) Less Complex in Design
c) Testing With Another HV Generation Device

VII. CONCLUSION

This holiday detector is easier for customer with advance features. User can easily operate this device. It is Safe having insulated fiber cabinet. It has more accuracy .But while handling this device user should carefully read the user manual. One caution is taken that before starting the device EARTH the wire to Metallic pipe with respect to ground. Some of this results are comes from theoretical concepts.

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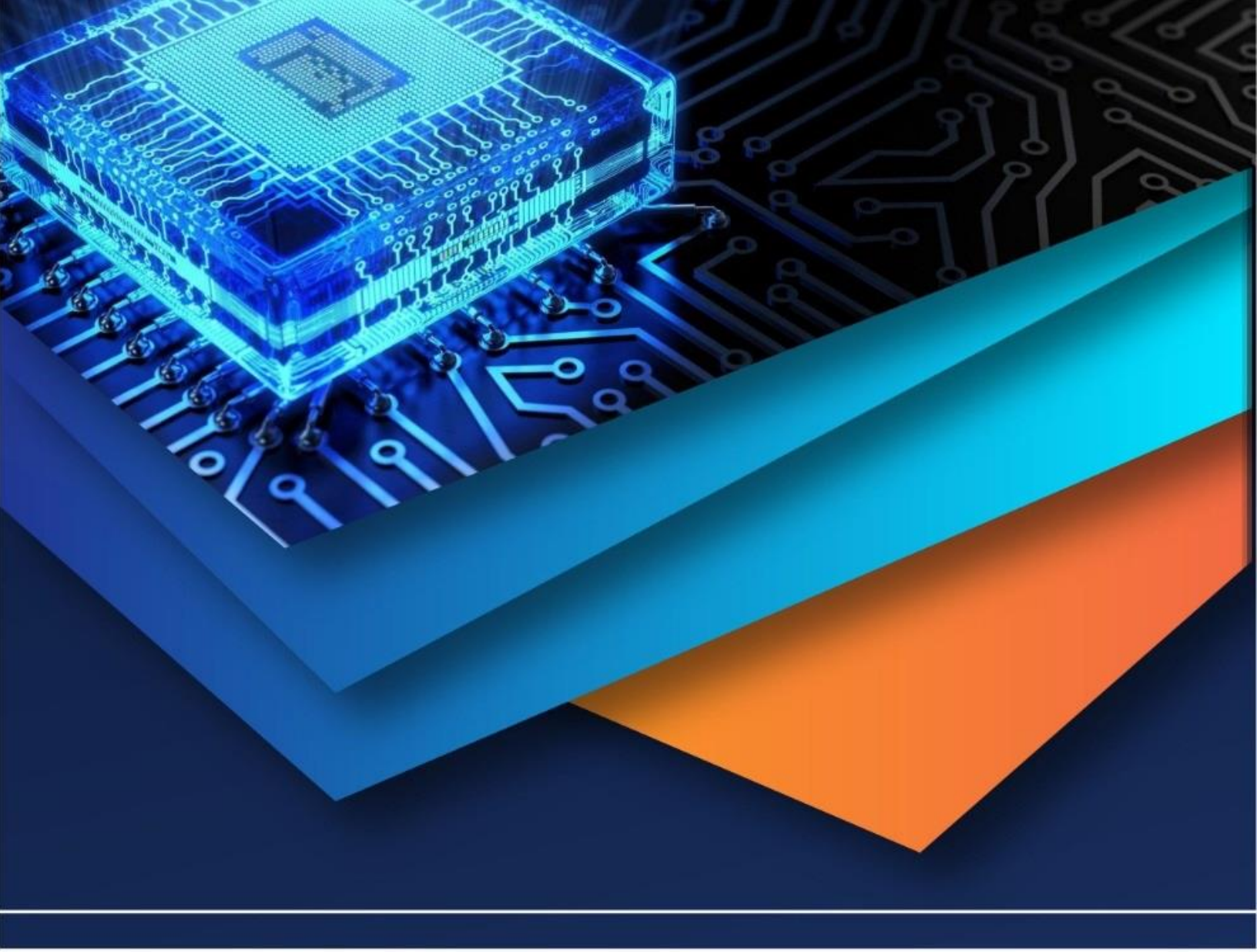

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