Ruggedized System Capable With Fully Water Proof & EMI Proof

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Abstract--The present Research relates to the other electronic modules and equipment for use in harsh military or commercial environments but in this ruggedized system, we are researched ruggedized system (harsh environment) with fully water proof and EMI proof. Due to water proof and EMI proof, this research has one of the different qualities. This rugged system can be used in all open environments like rain, sea, etc. and for EMI protection, we will use conductive materials like aluminum, iron, brass, chrome, and copper etc. for manufacturing of system parts (outer components) and will have to use conductive gasket for filling gap between two mounting parts, and conductive paint may also be used to reduce EMI. It have several specification such that light-Weight, vibration shock, salt atmosphere, and can be easily work in high temperature environment as well as low temperature environment. Due to light weight it can be easily transport one place to another place.

Keywords--EMI, EMC, rugged system, RF, material properties & composition, IP codes etc.

I. INTRODUCTION

A ruggedized system is specially designed to operate reliably in harsh usage environment conditions such as strong vibration extreme temperature and weight are dusty condition [1]. They are design from inception for the type of rough use typified by this condition, not just in the external housing but in the internal components and cooling arrangement as well [2]. In general, ruggedized and hardness system share the same design robustness and frequently these terms are interchangeable [3]. Typical end user environment for rugged laptop, tablet, pc, and electronic systems are public safety, field sales, field service, manufacturing, retail, health care, transpiration, and military. It can use in the agricultural industries and by individuals.

According to the present research, the ruggedized system of this research includes a light-Weight, temperature control means capable of maintaining system internal temperatures.
Permeation of water vapor through a materials or structure is reported as a water vapor transmission rate.

The hulls of boats and ships were once waterproofed by applying tar or pitch. Modern items may be waterproofed by applying water-repellent coatings or by sealing seams with gaskets or O-rings.

Waterproofing is used in reference to building structures (basements, decks, wet-areas, etc.), watercraft, canvas, clothing (raincoat, waders) and paper (e.g. milk and juice cartons).

For proper water proofing and EMI proofing,

We are using conductive type gasket between mounting of two parts or in any gap, due to which it will make proper water proof and EMI proof of ruggedized system. The goal of EMC is the correct operation, in the same electromagnetic environment, of different equipment which uses electromagnetic phenomena, and the avoidance of any interference effects.

A rugged system is a system specifically designed to operate reliably in harsh usage environments and conditions, such as strong vibrations, extreme temperatures and wet or dusty condition. Military cases rugged transit containers and shipping cases are used from 18th century in 1775 by the Army and Navy. Air force started in 20th century America in 1850. There were hundreds of trunk manufacturers in the United States.

II. OBJECTIVE

The objectives of this study are:

1. Design, build, such an instrument (electronics system) which works immersed in the water, rain (open environment), and harsh military or commercial environments.

2. It will be protect EMI emissions.

The rugged systems of this invention are a vibration isolator assemblies and thermal control of an operating environment of sensitive electronic equipment rugged system for use in a harsh field environment.

III. MATERIAL

3.1 Material selection for ruggedized system

Ruggedized systems are usually made from metals, particularly Stainless steel, carbon steel, and Aluminum.

There are different materials that are used in outer body of rugged systems, the material should be as strong as rock light weight and fire resistance etc. the present materials that are used in rugged systems are aluminum 6061. Due to light weight it can be easily transport one place to another place, and due to also conductive material properties, it will be protect from EMI radiation.

3.2 6061 Aluminum Properties

6061 aluminum properties include its structural strength and toughness. It is also offer good finishing characteristics and response well to anodizing, including clean and color dye and hard coat. 6061 aluminum alloy is also easily welded and joint. 6061 condition the weld may lose some strength, which can be restored by re-heat-treatment.

6061 aluminum alloys offer a remarkable spectrum of design opportunities to benefit consumer electronics manufacturers. The light weight materials enable you to trim precious ounces, coupled with high strength to make smaller, thinner components attainable.

3.2.1 Material property-

<table>
<thead>
<tr>
<th>Alloy temper</th>
<th>Ultimate tensile strength MPa</th>
<th>Tensile yield strength MPa</th>
<th>Elongation</th>
<th>Thermal (\text{conductive BTUin/hr-ft}^2 \text{ F})</th>
</tr>
</thead>
<tbody>
<tr>
<td>6061</td>
<td>345</td>
<td>290</td>
<td>13%</td>
<td>1160</td>
</tr>
</tbody>
</table>

Aluminum 6061 is one of the most versatile of the heat treatable alloy group. Alloy 6061 has good corrosion resistance and good weld ability.

3.2.2 Material compositions-

6061 aluminum is a hardening aluminum alloy, containing magnesium and silicon as its major alloying elements. Originally called“alloy61S,” it was developed in 1935[5].
3.2.3 Physical Properties of 6061 Aluminum

Density: 2.7g/cc

3.2.4 Mechanical Properties of 6061

Aluminum
Hardness, Brinell 95
Hardness, Knoop 120
Hardness, Rockwell 50
Hardness, Vickers 107
Ultimate Tensile Strength 310MPa
Tensile Yield Strength 276MPa
Modulus of Elasticity 68.9MPa
Notched Tensile Strength 324MPa
Ultimate Bearing Strength 607MPa
Bearing Yield Strength 386MPa
Poison Ratio 0.33
Fatigue Strength 96.5MPa
Machinability 50%
Shear Modulus 26MPa
Shear Strength 207MPa

3.2.5 Electrical Properties of 6061

Aluminum
Electrical resistivity 3.99e-006ohm-cm

3.2.6 Thermal Properties of 6061

Aluminum
Specific heat capacity 0.896J/g°C
Thermal conductivity 167W/mK
Thermal diffusivity 70
Thermal expansion 23.4μm/mK
Melting point 582-652°C

3.2.7 Processing property

Solution temperature 529°C
Aging temperature 160°C

3.3 Application: - Aluminum 6061 is commonly used in the manufacturing of heavy-duty structures requiring good corrosion resistance, truck and marine components, railroad cars, furniture, tank fittings, general structural and high pressure applications, wire products, and in pipe lines. Air-craft fitting, camera lens mounts, couplings, marine fittings and hardware, electrical fitting and connector, decorative or misc. Hardware, hinge pins, magneto parts, brake pistons, hydraulic pistons, appliance fittings, valves and valve parts, bike frames.

3.4 Standardization for ruggedized system

IP Code:-

The IP Code, International Protection marketing, IEC standard some time interpreted as Ingress Protection marketing.[6] classified and rates the degree of protection provided against intrusion, dust, accidental contact, and water by mechanical castings and electrical enclosures.

IP No. - Protection against solid objects
0- No special protection
1- Protection against accidental touch by hands
2- Protection against objects such as figure
3- Protection against tools and wires
4- Protection against tools, wires, small wires
5- Limited Protection against dust
6- Protected from dust

IP No. - Protection against liquids
0- No protection
1- Protection against vertically dropping condensation
2- Protection against direct sprays of water up to 15 degree from vertical.
3- Protection against direct sprays of water up to 60 degree from vertical.
4- Protection from sprays of water in all direction. Limited water ingress permitted
5- Protection from low pressure jets of water in all directions. Limited water ingress permitted
6- Nearly the same as 5th (point), except for ship deck
7- Protected against the effects of immersion in water to depth between 15cm and 1m.
IV. METHODS

1. Methods for water proofing of ruggedized system

The three measures developed to prevent this problem differ greatly in ideology and design. The three methods are:

1. Interior wall and floor sealers
2. Interior water drainage
3. Exterior drainage combined with waterproofing coatings

1. Interior sealants

Interior sealers will not provide permanent protection from water infiltration where hydrostatic pressure is present. Interior sealers are good for preventing high atmospheric humidity inside the basement, from absorbing into the porous masonry and to prevent spalling.

When the foundation is constructed of concrete blocks, an interior drain tile system, described below, can capture the water entering the block system and drain the water into a sump. This system will provide a dry and moisture free basement for years to come.

2. Interior water drainage

Wall conduits such as dimple boards or other membranes are fastened to the foundation wall and extend over the new drainage to guide any moisture down into the system. Foundation sump pumps can be installed through do-it-yourself kits, plumber installations, or by a professional waterproofing contractor. Interior basement waterproofing system should be prepared to work in the case of a power outage, the failure of a sump pump, and in the face of overwhelming torrential rain. A proper sump, backup sump pump, backup sump and battery backup sump pump should be installed in a large sump pit with an airtight lid for safety and to keep humidity from seeping through to the basement environment, where it can promote mold growth.

3. Exterior waterproofing

Exterior waterproofing prevents water from entering foundation walls therefore preventing the wicking and molding of building materials. Waterproofing a structure from the exterior is the only method the international building code recognizes as adequate to prevent structural damage caused by water intrusion.

1. Methods for EMI proofing of ruggedized system

EMI Control Methods

1. Filtering

- Suitably designed onboard filters should be considered for power supply circuits, i.e. Inductors, Capacitors etc.
- All the field line interface circuitry should be incorporated with the suitable filtering options, i.e. Ferrite beads.
- Onboard connectors can also be used with filtering options.

Circuit Impedance level control
Careful Selection and layout of Passive Components.

2. Cable Shields

1. Shields of external interconnecting cables essentially extensions of the chassis enclosure.
2. Shielding Effectiveness and Transfer Impedance
   i) Properties of material
   ii) Degree of coverage
   iii) Geometry
   iv) Shields are an important part of EMC design, especially in systems that require compliance to EMP and/or Indirect Lighting Effects.

3. Grounding

Grounding provides a conducting path between electronic devices and ground. The ground is nothing but some reference point. It is a circuit concept. The ideal ground is characterized by zero potential and impedance

2. Some example of EMI nuisance

1. Accident at foundry plant

A foundry worker died when the radio controlled overhead transporter thought out a few tons of liquid metal on him.

Cause: an accidental signal from a radio transmitter was interpreted by the automatic system as the legitimate order to get rid of load.

2. Burning crane

A burning worker was burned when touching the load of a crane installed for building operations.

Cause: an electric arc due to the radio frequency current induced in the metallic structure by a nearby broadcasting transmitter.
3. Pioneer Crash
Pioneer is the name of a remotely piloted vehicle using a portable remote control box. During its flight tests performed by the US Navy in January 1987 aboard the U.S.S. Iowa, the pilot experienced a series of uncommented man oeuvres that caused loss of control and a crash landing. Subsequent investigation found that the remote control boxes received false signals from HF combination transmitting antennas located aboard the Iowa due to inadequate shielding and cable termination [8].

4. Blackhawk Crashes
Between 1981 and 1987, five Blackhawk army helicopters crashed and filled or injured all on board when flew too near radio broadcast transmitters
Cause: insufficient immunity of flight (on-booed) control electronic sub-system against high intensity radiated fields (HIRF) that produced uncommented movements while flying past radio broadcast towers.

5. F-16 Flight Controls
An F-16 fighter jet crashed in the vicinity of it was pointed out that users experiencing medical equipment performance degradation might not suspect EMI as a possible cause. Thus, EMI problems are more likely to be under-reported to the FDA.
A Voice of America (VOA) radio transmitter because its fly-by-wire flight control system was susceptible to the radio waves transmitted.
Since the: F-16 is inherently unstable, the pilot must rely on the flight computer to fly the aircraft. Subsequently, many of the F-16’s were modified to prevent this type EMI, caused by inadequate military specifications on that particular electronics system. This F-16 case history was one of the drivers for institution by the Federal Aviation Administration (FAA) of the certification programs.
Tornado Fighter Case Another case occurred in 1984 near Munich, Germany. A West German Tornado fighter crashed after flying too close to a powerful Voice of America transmitter. Concerning EMI problems in the field

V. CONCLUSION OF RUGGEDIZED SYSTEM
Here, we are researched ruggedized system (harsh environment) with fully water proof and EMI proof.

It will be proper work in open environment. Due to water proof and EMI proof, this research has one of the different qualities. This rugged system can be used in all open environments like rain, sea, etc. and for EMI protection. It have several specification such that light-weight, vibration shock, salt atmosphere, and can be easily work in high temperature environment as well as low temperature environment. Due to light weight it can be easily transport one place to another place.

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REFERENCES
[1] Rugged laptop computer for use in military ground vehicles and helicopters offered by general dynamic Itronix - military and aerospace electronics.
[6] Understanding the IP(Ingress Protection) Rating