DESIGN AND DEVELOPMENT OF RUGGED LAPTOP

BITS ZG628T: Dissertation

by

(Insert Student Name)
(Insert Student ID Number)

Dissertation work carried out at

(Insert Organization Name, Location Name)

Submitted in partial fulfilment of **(Insert Programme Name)**
degree programme

Under the Supervision of

(Insert Supervisor Name)

(Insert Organization Name, Location Name)

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE

PILANI (RAJASTHAN)

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ABSTRACT

Rugged laptop is a personal computer for mobile use, which can be used as computing subsystem in any project. This is a Computing Platform based on Intel core i7 processor with 15” Display featuring rich I/O expansion for connecting communication devices.

Rugged laptop mainly consists of COM Express module, Carrier card, Interfaces PCBs, 15”display with touch screen, speaker, keyboard and Touchpad. External interfaces can be configured. Storage memory, RAM and battery configurations are also available based on the requirements. Processor module up gradation to higher version of COMEX module (Basic or Compact) caters easy up gradation of the system

ComEx (Computer on module Express) Module is a major component in the RLAP. This processor board has got Intel core i7 processor, power management circuit and all IO interfaces terminated on Type 6 ComEx standard connectors.

COM Express, a computer-on-module (COM) form factor, is a highly integrated and compact PC that can be used in a design application much like an integrated circuit component. Each COM Express Module COM integrates core CPU and memory functionality, the common I/O of a PC, USB, audio and Ethernet. All I/O signals are mapped to two high density, low profile connectors on the bottom side of the module. The COM modules plug into a baseboard that is typically customized to the application.

The weight of the system is not more than 6.5Kgs. The battery capacity should last for more than 8 hours. Indicators for power and battery status are available in the product.

Signature of the Student	**Signature of the Supervisor**
Name:	**Name:**
Date:	**Date:**
Place:	**Place:**

Contents

1. MODULES IN RUGGED LAPTOP

The main modules in RLAP are namely Com Express with 8 GB RAM, Real Time Clock, SATA storage, I/O interfaces, Display with touchscreen. All the modules are represented in Figure 1 below.

SYSTEM / SUB SYSTEM DESCRIPTION: RLAP system consists of following major components namely

(a) ComEx Module with RAM

(b) SATA Storage

(c) RTC battery (Bat1) and Power Button

(d) Keyboard

(e) LCD Display and Touch screen

(f) DVD Drive

(g) Battery IF Card and Battery

(h) IO IF card

(i) Speakers and Audio Jacks

The description of each of the major components is explained below:

a) **Comex Module with RAM** : ComEx (Computer on module Express) Module is a processor board which has got Intel core i7 processor, power management circuit and all IO interfaces terminated on Type 6 ComEx standard connectors.

   This module has got two DDR4 SODIMM RAM slots for memory interface on which 8 GB RAM is loaded on one slot. The module supports up to 32GB expandable memory including both slots.

b) **Comex Carrier**: ComEx **(**Computer on module Express) Carrier card interfaces to ComEx module via Type 6 standard connectors for all IO interfaces and power supply.

   All power supplies required for ComEx module are generated on Carrier board and IO interfaces are converted to suitable voltage levels required for userinterface. Power management and Battery charger controller are available on thiscard works based on the configuration of BIOS on ComEx module.

   PCIe based module, USB based module and SATA based module interfaces are terminated on this card on various connectors to connect respective modules.

c) **SATA Storage**: SATA storage device is a Solid State Device of 512 GB **storage** memory and it interfaces with SATA II/III of ComEx carrier. OS and local backup are stored in this device.

d) **RTC Battery and Power Button**: RTC CMOS battery is used for Real Time Clock (RTC) to keep the system date and time running during system off condition. This is not a rechargeable battery and it should be replaced if the system date and time are not matching with real time.

   Power button is a momentary push button which is used to Switch ON the RLAP by pressing once and force shut down of RLAP also can be performed bypressing and holding for 4 Seconds.

e) **Keyboard**: RLAP has got fully sealed standard QWERTY Keyboard for its input operations. Keyboard supports Backlight for night time operations.

f) **LCD Display:** LCD display is the major component of RLAP which displays output display functionalities and the system running status for user interface.

This 15 inch (diagonally) supports 1600 x 1200 resolution and brightness control feature. Display is protected by toughened glass to avoid scratches and display damage due to harsh environmental conditions. This glass type material has anti-glare feature.

g) **DVD Drive:** DVD drive is a Multimedia interface with SATA II/III with ComEx carrier and it supports CD/DVD ± R/W modes. It supports single layer, Double layer DVDs; manual and soft eject.

h) **Battery If Card and Battery**: Battery interface card used to connect smart Rechargeable 14.4V Li-ion battery for system backup. Battery will be charged via Battery charger controller available on ComEx carrier card through SMBus interface.

i) **IO IF Card:** IO interface card interfaces to ComEx carrier card via high speed connector with all External IO interfaces including DC power supply. All IO interfaces are terminated externally through standard connector with EMI filters and ESD protection.

j) **Speakers and Audio Jacks:** Two Built-in speakers interfaces to ComEx carrier card for Speaker out interface. Speakers supports stereo output with left and right speakers.

k) Two Audio Jacks are standard 3.5mm connectors for headphones and MIC. Audio jack supports stereo output and jack detect feature.

2. FUNCTIONAL BLOCK DIAGRAM/DESCRIPTION OF RUGGED LAPTOP

The battery B1 and B2 are connected through a SM Bus (System Management Bus). The SM Bus is a single ended simple two-wire bus for the communication to the power source to the motherboard for ON/OFF instructions. The 12V supply is provided to IC3790. 5V is the standby voltage. With 12V the Com Express module will be powered ON. The power management block is required for monitoring power connections and battery charges, charging of batteries when necessary, regulating the real-time clock in RLAP. The functional block diagram of RLAP is shown below inFigure 2.

The Com Express module connects all the interfaces, audio codec for speaker, LVDS display, SATA storage and SATA DVD.

1. INTERFACES

a) USB interface: designed to standardize the connection of peripherals. Examples of peripherals that can be connected via USB include computer keyboard, mice, video cameras, printers, portable media players, disk drives.

b) **Ethernet interface:** networking interface which allows the computer to connect to Local Area Network(LAN)

c) **Serial interface:** a communication interface that transmits data as a single stream of bits. Can be used for communication between two Laptops.

d) **VGA interface:** An interface between RLAP and other monitor. It can used for Interface for video output, extended display and as monitor with higher resolution.

2. AUDIO CODEC

Audio codec is capable of encoding or decoding a digital data stream (a codec) that encodes or decodes audio.

3. RS232 TRANCEIVER

Is a serial communication used for transmission of data . The choice of MAX 3243 has the capability of auto-power-down is used to automatically save power when the receivers are unconnected.

4. RTC BATTERY

The RTC battery provides power for the internal clock/calendar and for maintaining system configuration settings.

3. MAJOR TECHNICAL SPECIFICATIONS OF RLAP

SL no	Technical parameter	
1.	Processor used	Intel core i7Gen
2.	Processor Frequency	2.6GHz, Max. Turbo 3.4GHz
3.	Cache	4MB smart cache. Smart Cache shares the actual cache memory between the cores of a multi-core processor.
4.	Memory	8GB DDR4 expandable upto 16GB
5.	Storage	512GB mSATA SSD
6.	Graphics	Intel HD Graphics 520
7.	Keyboard	Fully sealed QWERTY with Backlight
8.	Display	15” TFT LCD display, Sun-readable, 1600x1200 Pixels
9.	DVD Drive	Integrated SATA DVD RW
10.	LAN	3- Giga bit Ethernet circular connector
11.	Serial Port	3- standard serial circular connector
12.	External Display	1- standard VGA circular connector, 1 Display

		port
13.	USB	3- USB 2.0 port circular connector 2- USB 3.0 Port circular connector
14.	Audio	1- Audio IN, 1- Audio OUT Port and 2- Built in speakers
15.	Battery	Dual Li-ion, 14.4V, 6.8Ah Rechargeable
16.	Power	1-Power IN circular Connector, Nominal 18 to 28V DC Input with External AC-DC adapter
17.	OS	WIN 10 64bit/ RHEL 7.x
18.	Dimensions	370±5.0 x 323±5.0 x 76±5.0 mm
19.	Environmental	JSS 55555- Class L2J/L3
20.	Weight	≤ 5.1 Kg
21.	Cable assemblies	Ethernet, USB TYP 1, USB TYP 2, VGA, Serial, AC-DC adapter

Table 1: TECHNICAL SPECIFICATIONS OF RLAP

4. DESIGN CONSIDERATIONS:

- System supports windows, Linux Operating system
- FMEA analysis
- MIL STD 1472G for man portability of the product, modular design and mobile feature of the product is incorporated.
- List of cables used: Display LVDS cable, power cable, DC IN power cable, speaker cable, audio jack cable, battery cable.

5. FUTURE PLAN:

Sl No	**Phases**	**Start Date – End Date**	**Work to be done**	**Status**
1	Dissertation outline	05 Jan 2021 – 04.02.2021	Literature review and prepare Dissertation outline	COMPLETED
2	Design and Development	05.02.2021 – 20.03.2021	Design & Development Activity	COMPLETED
3	Testing	22.03.2021 –	Software Testing,	PENDING

		06.04.2021	User Evaluation and Conclusion	
4	Dissertation Review	07.04.2021 – 12.04.2021	Submit dissertation to supervisor & Additional Examiner for review and feedback	PENDING
5	Submission	13.04.2021 – 19.04.2021	Final Review and submission of dissertation	PENDING

6. ABBREVIATIONS

ComEx	Computer on module Express
CPU	Central Processing Unit
DDR	Double Data Rate
DVD	Digital versatile disc
I/O	Input/Output
IF	Interface
LAN	Local Area Network(LAN)
LVDS	Low Voltage Differential Signalling
PC	Personnel Computer
PCB	Printed Circuit Board
PCIe	peripheral component interconnect express
RAM	Random Access Memory
RLAP	Rugged laptop
RTC	Real Time Clock
SATA	Serial Advanced Technology Attachment
SMBus	System Management Bus
USB	Universal Serial Bus
VGA	Visual Graphics Array