

Lcd tv power supply unit schematic Textbook

Lcd tv power supply unit schematic

Understanding the inner workings of an LCD TV power supply unit (PSU) schematic is essential for technicians, electronics enthusiasts, and anyone interested in troubleshooting or repairing modern televisions. The power supply unit is the backbone that ensures the proper delivery of voltage and current to various components within the TV, enabling it to function correctly. This comprehensive guide aims to provide an in-depth overview of LCD TV power supply schematics, explaining their structure, key components, common troubleshooting techniques, and safety considerations.

Introduction to LCD TV Power Supply Units

A power supply unit in an LCD TV converts the AC mains voltage into various DC voltages required for different parts of the device. These include the backlight inverter, logic boards, T-Con board, and other critical modules. Given the complexity and high voltages involved, understanding the schematic is crucial for effective repair and maintenance.

Basic Structure of LCD TV Power Supply Schematics

An LCD TV PSU schematic typically includes several sections:

Input Section

- AC Power Input: Connects to the mains supply, usually via a power cord and an IEC connector.
- EMI Filter and Fuse: Protects against electrical noise and overcurrent conditions.
- Rectifier and Filter: Converts AC to DC, smoothing out ripples.

Switching Power Supply Section

- High-Frequency Transformer: Isolates and steps down voltage.
- Switching Regulator (PWM Controller): Manages power conversion efficiently.
- Switching Transistor (MOSFET): Acts as the main switch for the converter.
- Feedback Circuit: Regulates output voltage by adjusting switching parameters.

Output Section

- DC Voltage Rails: Provide stable voltages (e.g., +12V, +24V, +5V) for different components.
- Protection Circuits: Overvoltage, overcurrent, and short-circuit protection.
- Backlight Inverter: Supplies high-voltage pulses to CCFLs or LED backlights, often integrated within the PSU schematic.

Key Components in an LCD TV Power Supply Schematic

Understanding the major components helps in diagnosing issues and interpreting the schematic:

Transformer

- Converts voltage levels and provides galvanic isolation.
- Often a high-frequency transformer in switching power supplies.

Rectifier and Filter Components

- Diodes (e.g., bridge rectifiers) convert AC to pulsating DC.
- Capacitors smooth out ripples for stable DC supply.

Switching Controller IC

- Regulates the switching transistors.
- Examples include ICs like TDA8932, SG3525, or dedicated LCD TV power ICs.

Output Rectifiers and Filters

- Schottky diodes or fast-recovery diodes.
- LC filters to stabilize voltage outputs.

Protection Circuitry

- Overvoltage protection (OVP)
- Overcurrent protection (OCP)
- Short-circuit protection (SCP)

Backlight Inverter (if applicable)

- Generates high voltage for CCFL backlights.
- Comprises oscillators, transformers, and rectifiers specialized for high voltage.

Understanding the LCD TV Power Supply Schematic Diagram

Interpreting the schematic involves recognizing how these components are interconnected:

- The AC input flows through the EMI filter and fuse to the rectifier, which converts AC to DC.
- The rectified DC charges filter capacitors, providing a stable voltage input for the switching regulator.
- The switching regulator, controlled by a PWM IC, switches the power transistor on and off at high frequency.
- The high-frequency transformer steps down the voltage, isolating the secondary side, which supplies various DC rails.
- Feedback mechanisms monitor the output voltage and adjust the PWM signal to maintain regulation.
- Additional circuits provide protections against faults, shutting down the power supply if anomalies are detected.

Common Issues in LCD TV Power Supply Units and Their Schematics

Common problems can often be diagnosed by examining the schematic and understanding the typical failure modes:

No Power / Power On Failure

- Blown fuse or damaged rectifier diodes.
- Faulty switching regulator IC.
- Open or shorted power transistors.

Intermittent Power or Flickering

- Faulty or leaky filter capacitors.
- Loose connections or damaged solder joints.
- Overheating components.

Overvoltage or Overcurrent Conditions

- Damaged feedback circuit.
- Shorted output diodes.
- Faulty protection circuitry.

Backlight Issues

- Faulty inverter section or high-voltage transformer.
- Damaged CCFL lamps or LED strips.
- Inverter driver IC failure.

Troubleshooting LCD TV Power Supply Units Using Schematics

Effective troubleshooting involves several steps:

- Visual Inspection: Check for obvious damages such as burnt components, bulging capacitors, or broken connectors.
- Measure Voltages: Using a multimeter, verify output voltages against the schematic's specifications.
- Check Fuses and Diodes: Ensure they are not open or shorted.
- Test Transistors and ICs: Use a component tester or replace suspected faulty parts.
- Examine Feedback Loop: Confirm that the feedback signals are within normal range, ensuring regulation.
- Inspect High-Voltage Section: Be cautious due to high voltages when testing the inverter circuitry.

Safety Precautions When Working with LCD TV Power Supply Schematics

Working with power supplies involves risks due to high voltages:

- Always unplug the device and discharge capacitors before working.
- Use insulated tools and wear protective gear.
- Be cautious around the high-voltage inverter section.
- Follow proper procedures and consult the schematic thoroughly before making repairs.

Conclusion

A thorough understanding of the LCD TV power supply unit schematic is invaluable for diagnosing,

repairing, and maintaining modern televisions. By familiarizing oneself with the schematic's structure, key components, and troubleshooting techniques, technicians can efficiently identify faults and restore functionality. Remember, safety is paramount when working with high-voltage circuits, and always refer to the specific schematic for the model at hand, as designs may vary. With practice and knowledge, mastering the LCD TV PSU schematic becomes an essential skill for effective repair and maintenance in the electronics field.

LCD TV Power Supply Unit Schematic: An In-Depth Technical Guide

Introduction

The phrase lcd tv power supply unit schematic often conjures images of complex circuitry and electronic intricacies. For technicians, engineers, or tech enthusiasts, understanding the inner workings of an LCD TV's power supply is crucial for troubleshooting, repair, or designing compatible replacements. This article aims to demystify the schematic of an LCD TV power supply unit (PSU), explaining its core components, functions, and common issues, all in a reader-friendly yet technically precise manner.

Understanding the Role of the Power Supply in an LCD TV

Before delving into schematics, it's essential to comprehend the fundamental role of the PSU within an LCD television. Unlike traditional CRTs, LCD TVs rely heavily on sophisticated electronic circuits to convert mains AC power into the various DC voltages required by their components.

Main Functions of the Power Supply Unit:

- AC to DC Conversion: Stepping down and rectifying mains voltage (typically 100-240V AC) into usable DC voltages.
- Voltage Regulation: Ensuring stable output voltages despite fluctuations in input power or load conditions.
- Power Distribution: Supplying different voltages to the backlight, logic board, T-Con board, and other modules.
- Protection: Incorporating safety features like overload, overvoltage, and short-circuit protections.

Understanding these functions helps when analyzing the schematic, as each component and circuit segment plays a role in fulfilling these objectives.

Anatomy of an LCD TV Power Supply Unit Schematic

An LCD TV power supply schematic can be broadly categorized into several key sections:

- Input Filtering and Rectification
- High-Frequency Switching Circuit
- Transformer and Inductors
- Output Rectification and Filtering
- Feedback and Regulation Circuitry
- Protection Circuits

Let's explore each of these in detail.

- Input Filtering and Rectification

Purpose: To prepare the incoming AC power for conversion and protect the circuitry from surges and noise.

Key Components:

- EMI Filter: Comprising inductors and capacitors to suppress electromagnetic interference.
- Fuse: Provides safety by disconnecting power during fault conditions.
- Rectifier Bridge (Diode Bridge): Converts AC to pulsating DC.

Operation:

The AC mains enter the EMI filter, which reduces high-frequency noise and protects downstream circuits. Following this, the diode bridge rectifies the AC voltage, resulting in a pulsating DC waveform. The pulsating DC is then smoothed by bulk electrolytic capacitors to form a stable DC voltage for the switching stage.

- High-Frequency Switching Circuit

Purpose: To efficiently convert the rectified DC into high-frequency AC, enabling compact transformer design and efficient power transfer.

Key Components:

- PWM Controller IC: Regulates switching frequency and duty cycle.
- Switching Transistors (MOSFETs): Switch the current on and off at high frequency.
- Snubber Circuits: Protect transistors from voltage spikes.

Operation:

The PWM controller modulates the MOSFETs, turning them on and off rapidly. This switching action creates a high-frequency AC signal flowing through the transformer. The high-frequency operation allows for smaller transformer sizes and improved efficiency.

- Transformer and Inductors

Purpose: To step down the high-frequency AC into multiple secondary voltages needed by different parts of the TV.

Key Components:

- High-Frequency Transformer: Provides galvanic isolation and voltage transformation.
- Chokes/Inductors: Smooth current and reduce ripple.

Operation:

The transformer receives the high-frequency AC, stepping down the voltage to various levels ? such as 12V, 5V, or 24V, depending on the design. The secondary windings are connected to rectification circuits to produce stable DC outputs.

- Output Rectification and Filtering

Purpose: To convert the high-frequency AC from the transformer back into stable DC voltages suitable for the TV's internal components.

Key Components:

- Output Diodes (Schottky or Fast Recovery Diodes): Rectify the secondary voltages.
- Filtering Capacitors: Reduce ripple and noise, ensuring smooth DC outputs.
- Voltage Divider Networks (if applicable): For setting reference voltages.

Operation:

The secondary AC signals are rectified by diodes, and the resulting DC is filtered by large electrolytic capacitors. This ensures that the power supplied to the LCD panel, backlight, and logic

board is clean and stable.

- Feedback and Regulation Circuitry

Purpose: To maintain constant output voltages despite input fluctuations or load changes.

Key Components:

- Optocouplers: Provide galvanic isolation between the primary and secondary sides.
- Error Amplifiers: Sense output voltage and control the PWM duty cycle.
- Reference Voltage ICs: Provide a stable reference point for regulation.

Operation:

A portion of the secondary voltage is fed back via the optocoupler to the PWM controller. If the output voltage drifts, the feedback signal adjusts the switching duty cycle, increasing or decreasing power transfer to maintain a constant voltage.

- Protection Circuits

Purpose: To safeguard the TV and its components from abnormal conditions.

Common Protections:

- Overcurrent Protection (OCP): Cuts off power if current exceeds safe limits.
- Overvoltage Protection (OVP): Prevents excessive voltage delivery.
- Short-Circuit Protection (SCP): Detects and responds to shorts.
- Thermal Shutdown: Turns off the supply if overheating.

Implementation:

Protection circuits monitor various parameters and, upon detecting faults, disable the switching circuit, often via the PWM controller, to prevent damage.

Common Faults and Troubleshooting Based on the Schematic

Understanding the schematic aids in diagnosing common issues:

- No Power / No Output Voltages: Often caused by blown fuses, faulty rectifier diodes, or damaged switching transistors.
- Poor Backlight or Dim Display: Might indicate faulty secondary voltage regulators or open-circuited transformers.
- Overvoltage or Overcurrent Conditions: Could be due to failed feedback circuitry or defective protection components.
- Strange Noise or Sparks: Signaling component failures, such as damaged capacitors or diodes, or transformer issues.

Safety Precautions and Best Practices

Working with LCD TV power supplies involves high voltages, sometimes exceeding 300V DC. Always:

- Disconnect power before servicing.
- Use insulated tools.
- Follow proper grounding procedures.
- Replace components with specified ratings.

Conclusion

The lcd tv power supply unit schematic encapsulates a complex yet methodical design aimed at delivering reliable, efficient power to the entire television system. By understanding the schematic's core sections—input filtering, high-frequency switching, transformer action, output regulation, and protection—technicians and engineers can better diagnose issues, perform repairs, or even design their own power supplies.

While schematics may seem daunting at first glance, breaking them down into these functional modules makes the task manageable. As LCD technology continues to evolve, so too do power supply designs, emphasizing efficiency, safety, and compactness. Mastery of these schematics is essential for anyone involved in the maintenance and development of modern television technology.

Question What are the common components found in an LCD TV power supply unit schematic? **Answer** Common components include the rectifier bridge, filter capacitors, switching regulators, transformers, inductors, and various protection circuits such as overcurrent and overvoltage protection modules. **Question** How can I troubleshoot a faulty LCD TV power supply unit schematic? **Answer** Begin by visually inspecting for burnt components or damaged capacitors, then use a multimeter or oscilloscope to check voltage outputs and continuity. Refer to the schematic to identify test points and component values for accurate diagnosis. **Question** What are the typical voltage outputs in an LCD TV power supply schematic? **Answer** Typical outputs include 5V, 12V, and sometimes 24V DC rails used to

power different sections of the LCD TV, such as the backlight inverter, main board, and T-Con board. Why is understanding the LCD TV power supply unit schematic important for repairs? Understanding the schematic allows technicians to accurately identify faulty components, trace power flow, and perform efficient repairs, reducing troubleshooting time and preventing further damage. Are there any safety precautions to consider when working with LCD TV power supply schematics? Yes, always unplug the device before working on it, discharge capacitors properly, and use insulated tools. High voltages can be present even after power is disconnected, so proper safety measures are essential.

Related keywords: LCD TV power supply, PSU circuit diagram, LCD TV power board schematic, power supply circuitry, LCD TV power supply repair, inverter circuit diagram, LED TV power supply schematic, power supply troubleshooting, LCD TV power unit schematic, power supply component layout

Kom Unit 2

Understanding Kom Unit 2: An In-Depth Exploration

kom unit 2 is a term that often appears in various contexts, ranging from educational curricula to specific organizational units within different sectors. To fully grasp its significance, it is essential to analyze its origins, applications, and the core components that define it. Whether you are a student, a professional, or an enthusiast seeking comprehensive knowledge, this article aims to provide a detailed overview of Kom Unit 2, shedding light on its multifaceted nature.

Origins and Definition of Kom Unit 2

Historical Background

The term "Kom" can originate from different languages and disciplines, but in many contexts, it is associated with organizational or military terminology. The designation "Unit 2" suggests a subdivision within a larger structure, often representing a specific department, module, or functional segment.

Historically, the concept of dividing entities into units or modules has been prevalent across various fields to improve specialization, efficiency, and clarity. Kom Unit 2 may stem from such organizational strategies, tailored to meet the needs of particular industries or educational frameworks.

What Is Kom Unit 2?

At its core, Kom Unit 2 refers to the second segment or module within a broader system called "Kom." Depending on the setting, "Kom" could stand for:

- A course module in an academic program
- A specific operational unit within an organization
- A part of a technical system or software

In most contexts, Kom Unit 2 signifies a structured component designed to build upon foundational knowledge or functions established in Unit 1, offering advanced concepts, skills, or responsibilities.

Application Areas of Kom Unit 2

Educational Contexts

Within academic curricula, especially in technical and vocational training, Kom Unit 2 often forms part of a modular learning program. For example:

- **Technical Courses:** It might cover advanced topics like system design, programming, or engineering principles.
- **Language Learning:** It could involve intermediate grammar, vocabulary expansion, and conversational skills.
- **Professional Development:** Focused on practical applications and real-world scenarios.

In such settings, successfully completing Kom Unit 2 indicates progression to more complex topics, preparing learners for further modules or certification.

Organizational and Military Usage

In organizational or military terminology, Kom Unit 2 could refer to:

- A specific team or squad responsible for particular operational tasks
- A subdivision within a command structure
- A specialized task force focusing on a defined mission

Understanding its role within the larger framework is crucial for effective coordination and operational success.

Technical and Software Systems

In technical systems, especially in software or hardware configurations, Kom Unit 2 might denote:

- A particular module or component within a system architecture
- A version or iteration of a software package
- A functional segment responsible for specific operations, such as data processing or communication

Developers and engineers rely on this segmentation for troubleshooting, upgrades, and system optimization.

Core Components of Kom Unit 2

Key Features and Characteristics

While the specifics can vary considerably based on the context, some common features of Kom Unit 2 include:

- **Progressive Complexity:** It builds upon foundational knowledge from Unit 1, introducing more advanced concepts.
- **Specialized Content:** Focused on particular skills or topics relevant to the field.
- **Structured Learning or Operation:** Organized into modules, lessons, or tasks to facilitate systematic progress.
- **Assessment Criteria:** Includes evaluations to measure understanding or performance.
- **Integration with Other Units:** Designed to connect seamlessly with previous and subsequent modules or units.

Skills and Knowledge Acquired

Depending on the domain, students or professionals engaging with Kom Unit 2 can expect to develop:

- Deepened understanding of core principles
- Practical skills applicable to real-world scenarios
- Problem-solving abilities
- Technical proficiency in specific tools or systems
- Critical thinking and analytical skills

Importance of Kom Unit 2

Advancement in Learning and Career

Completing Kom Unit 2 often signifies a significant step forward in a learning journey or career path. It prepares individuals for:

- Handling more complex tasks
- Assuming greater responsibilities
- Specializing in niche areas
- Preparing for certification exams or professional accreditation

Operational Efficiency and Effectiveness

Within organizations, the proper functioning of Kom Unit 2 ensures:

- Enhanced productivity
- Better coordination among units
- Improved quality of outputs
- Streamlined workflows

Challenges and Considerations in Implementing Kom Unit 2

Potential Challenges

Implementing or mastering Kom Unit 2 can involve obstacles such as:

- Complexity of content or tasks
- Resource limitations
- Lack of adequate training or support
- Resistance to change within organizations
- Technological barriers

Strategies for Successful Deployment

To overcome these challenges, consider:

- Providing comprehensive training programs
- Ensuring clear communication of objectives and expectations
- Allocating sufficient resources and infrastructure
- Encouraging feedback and continuous improvement
- Integrating support systems for learners or operators

Future Outlook of Kom Unit 2

Emerging Trends

With advancements in technology and education, Kom Unit 2 is expected to evolve in several ways:

- Incorporation of digital tools and e-learning platforms
- Increased emphasis on practical, hands-on experiences
- Integration of artificial intelligence and automation
- Customization of modules to cater to individual needs
- Enhanced assessment and feedback mechanisms

Potential Developments

Future developments might include:

- More seamless integration with other units and systems
- Adaptive learning pathways
- Greater focus on interdisciplinary skills
- Expansion into new fields and industries

Conclusion

In summary, **kom unit 2** represents a pivotal stage within various frameworks, whether educational, organizational, or technical. Its significance lies in fostering deeper understanding, enhancing skills, and supporting progression. As industries and educational paradigms continue to evolve, so too will the role and structure of Kom Unit 2, adapting to meet emerging challenges and opportunities. For individuals and organizations alike, mastering this unit can serve as a foundation for sustained growth and success in their respective domains.

Kom Unit 2 is a pivotal component in understanding the broader framework of the Kom series, offering a nuanced look into the core principles, practical applications, and strategic implications of the second module. Whether you're a newcomer seeking foundational insights or an experienced

professional aiming to deepen your knowledge, this comprehensive guide will walk you through everything you need to know about Kom Unit 2, from its key features to its real-world relevance.

Introduction to Kom Unit 2

Kom Unit 2 builds upon the foundational concepts introduced in the initial module, delving into more advanced topics that are critical for mastery. It emphasizes not just theoretical understanding but also practical application, making it essential for anyone looking to leverage Kom's full potential in their workflows or strategic planning.

In essence, Kom Unit 2 serves as a bridge between introductory knowledge and expert-level proficiency, equipping users with the tools and insights necessary to navigate complex scenarios efficiently.

Overview of Key Concepts in Kom Unit 2

Expanded Functionality and Features

While Kom Unit 1 focused on basic setup and introductory features, Kom Unit 2 explores advanced functionalities, including:

- Enhanced customization options
- Deeper integration capabilities with other tools
- Advanced data analysis techniques
- Automation of complex workflows

Core Principles Reinforced

The module emphasizes several core principles:

- Flexibility: Adapting Kom to diverse environments
- Scalability: Managing increasing data volume and complexity
- Efficiency: Streamlining processes to save time and resources
- Security: Ensuring data integrity and privacy

Deep Dive into Kom Unit 2 Components

- Advanced Data Management

Kom Unit 2 introduces sophisticated methods for handling data, such as:

- Multi-layered data filtering
- Real-time data synchronization
- Data validation and cleansing tools
- Hierarchical data structures

These features enable users to manage larger datasets more effectively, ensuring accuracy and consistency.

- Customization and Personalization

This unit emphasizes the importance of tailoring the platform to specific needs:

- Custom dashboards and reports
- User-specific workflows
- Personalized notifications and alerts
- Modular plugin integrations

- Integration and Automation

Seamless integration with other tools is a highlight:

- API connections with third-party applications
- Automating repetitive tasks with scripting
- Trigger-based workflows
- Cross-platform data sharing

Automation reduces manual effort and minimizes errors, leading to more reliable outputs.

- Security and Compliance

Given the increasing importance of data security:

- Role-based access controls
- Encryption protocols
- Audit trails and activity logs
- Compliance with industry standards (GDPR, HIPAA, etc.)

Practical Applications of Kom Unit 2

Business and Enterprise Use Cases

- Data-Driven Decision Making: Leveraging advanced analytics to inform strategic choices.
- Process Automation: Streamlining operations such as inventory management, customer relations, or financial reporting.
- Custom Reporting: Creating tailored reports for stakeholders, enabling better insights.
- Security Protocols: Ensuring sensitive data remains protected across workflows.

Educational and Research Applications

- Managing large datasets for research projects
- Automating data collection and analysis
- Developing custom tools for specific research needs

Industry-Specific Implementations

- Healthcare: Managing patient data securely
- Finance: Automating transaction processing
- Retail: Enhancing inventory and sales analytics

Best Practices for Maximizing the Benefits of Kom Unit 2

- Planning and Requirement Gathering

Before diving into implementation, clearly define:

- Business objectives
- Data sources and types
- Integration points

- Security requirements

- Step-by-Step Deployment

- Start with pilot projects
- Gradually scale functionalities
- Collect user feedback for continuous improvement

- Training and Support

- Provide comprehensive training sessions
- Develop detailed documentation
- Establish support channels for troubleshooting

- Continuous Monitoring and Optimization

- Regularly review workflows and data quality
- Update automation scripts as needed
- Stay informed about new features and updates

Challenges and Solutions in Implementing Kom Unit 2

While Kom Unit 2 offers powerful capabilities, implementation can pose challenges:

Common Challenges

- Data integration complexities
- Resistance to change from staff
- Managing security and compliance
- Ensuring system scalability

Solutions and Recommendations

- Conduct thorough planning and testing
- Engage stakeholders early
- Invest in training and change management
- Use scalable infrastructure and modular design

Future Outlook for Kom Unit 2

The evolution of Kom Unit 2 is poised to continue, with upcoming features focusing on:

- Artificial Intelligence integration for predictive analytics
- Enhanced user interfaces for easier interaction
- Broader automation capabilities
- Improved security protocols

As organizations increasingly rely on data-driven strategies, mastering Kom Unit 2 will become even more critical for competitive advantage.

Final Thoughts

Kom Unit 2 represents a significant step forward in harnessing the full potential of the Kom platform. Its focus on advanced features, customization, integration, and security makes it an indispensable tool for modern organizations seeking efficiency and strategic insight. By understanding its core components, applications, and best practices, users can unlock new levels of productivity and innovation.

Whether you're looking to optimize existing workflows or develop new capabilities, investing time in mastering Kom Unit 2 will pay dividends in operational excellence and data empowerment.

Question What are the main topics covered in KOM Unit 2? KOM Unit 2 typically covers advanced communication concepts, including digital communication systems, signal processing, and network protocols relevant to modern telecommunications. **How can I prepare effectively for the KOM Unit 2 exam?** Focus on understanding key principles of digital communication, practice solving problem sets, review past exams, and ensure you grasp the theoretical concepts alongside practical applications. **What are common challenges students face in KOM Unit 2?** Students often struggle with complex signal processing topics, understanding network architectures, and applying theoretical knowledge to real-world scenarios. Regular practice and seeking clarification help overcome these hurdles. **Are there any recommended resources for studying KOM Unit 2?** Yes, textbooks on digital communication systems, online lecture videos, academic papers, and university-provided lecture notes are valuable resources to deepen your understanding of KOM Unit 2 topics. **How does KOM Unit 2 relate to current industry trends?** KOM Unit 2's focus on advanced

communication and network technologies aligns with current industry developments like 5G, IoT, and AI-driven communication systems, making it highly relevant for future careers. What practical skills will I gain from KOM Unit 2? Students will develop skills in analyzing communication systems, designing signal processing algorithms, and understanding network protocols, which are essential for careers in telecom and data communication fields. Is prior knowledge in basic communication theory necessary for KOM Unit 2? Yes, a solid understanding of foundational communication concepts from previous units is essential to grasp the advanced topics covered in KOM Unit 2 effectively.

Related keywords: kom unit 2, kom unit 2 syllabus, kom unit 2 syllabus 2023, kom unit 2 exam, kom unit 2 past papers, kom unit 2 notes, kom unit 2 preparation, kom unit 2 guide, kom unit 2 questions, kom unit 2 marks

Read the full article online: [kom unit 2](#)