Vid -26/ 555 Timer IC:

Bangladesh Bank

→ This version can be achieve an output voltage very close to the supply voltage through the use of MOSFETs as the output stage and thus can creat a 50% duty cycle with ease.

It consumes less current, achieve higher frequencies and work with lower supply voltage.

Bangladesh Bank

video-27 | ADC
(Analog to Digital converter)

→ Converts an analog input voltage to a 10-bit digital value through minimum value min. value represents GND and the maximum value represents the voltage LSB.

→ 200kHz sampling rate.

→ ~~DIY~~ The ADC, which is more appropriate for DIY is called a flash ADC.

Bangladesh Bank

vid-28: IGBT and when to use them
Insulated Gate Bipolar Transistor

→ All IC does is connecting the gate either to the supply voltage or ground. to charg it up or discharge it.

→ IGBTs are utilized for applications beneath 200 kHz and MOSFETs for everything above.

vedio-29 | Solar panel & Charge controller:

Solar panel → insists of solar cells.

→ Small solar panel →
- 12 cells in series

→ ~~bypass diodes~~

Bangladesh Bank

STC → Standard Test Conditions.

MPP → Maximum Power point.

Vid-30: Microcontroller (Arduino) Timers:

→ increment automatically base on a clock.

→ Can be used for precise time delays, PWM generation or triggering interrupts.

→ Each Arduino timer has specific registers: TCCRn A/B, OCRn, TIMSK, TCNTn.

→ PWM is created by comparing the timer value to a threshold. controlling the duty cycle.

→ Direct register manipulation provides more precise and flexible control than using delay() or analogWrite().

→ Using interrupts with timers allows the microcontroller to respond to events without polling.

তথ্য অধিকার, সংকটে হাতিয়ার

Vid-31: Schottky diodes & Zener diode.

Bangladesh Bank

- A schottky diode is formed by the junction of a metal with a semiconductor, resulting in a diode with distinct properties.

→ 0.15V to 0.45V, ~~it~~ convert AC→DC limiting voltage spikes.

→ Fast speed switch

- A Zener diode is designed to allow current to flow in the reverse direction when the voltage exceeds a specific value, known as Zener breakdown voltage ~0.7V (standard diode).

→ Moderate speed switch,

তথ্য অধিকার, সংকটে হাতিয়ার

Bangladesh Bank

Vid: 32 (Relays & Octocouplers)

Relays:

→ electronic switch that uses an electromagnet to mechanically operate a switch, allowing one circuit to control another, often with diff voltage level.

→ switch high power to low-power signal.

→ config: SPST, SPDT, DPDT etc.

→ Used in Home automation system

Optocouplers (Opto-Isolators)

→ a component that transfer electrical signals between two isolated circuits using light.

consists of, LED and photodetector.

→ smaller and faster that Relays.

Bangladesh Bank

Vid-33: Strain Gauge / Load Cell and How to use them to ~~Measure Weight~~.

- a sensor that measures the amount of strain (deformation) in an object. When an object is subjected to force, it deforms slightly, and the strain gauge detects this deformtn by experiencing a change in its electrical resistence.

- A load cell is a transducer that converts force into an electrical signal. It incorporates strain guage to detect the deformatn caused by the applied load.

vid-34: Two-position Controller & PID Controller

Bangladesh Bank

- Two-position controller operates by switching the output fully on or off based on the error between a desired setpoint and the current process value.

- A PID-CONTROLLER provides a more refined control by considering three components.
  - i) Proportional (P): responds to current error.
  - ii) Integral (I): accounts for accumulation of past errors, aiming to eliminate steady-state errors.
  - iii) Derivative (D): Predicts future errors.

vid-35: Schmitt Trigger and when to use them?

Bangladesh Bank

→ is a comparator circuit with hysteresis, meaning it has two distinct threshold voltage levels. One for transitioning from low to high output and another for transitioning from high to low.

→ helps to eliminate noise and provide clear digital signal from noisy or slowly varying output.

Application:

i) Signal Conditioning
ii) Debouncing Switches
iii) Oscillator Circuits.

Vid-36: SPI and How to use it:

Bangladesh Bank

SPI - Serial Peripheral Interface is a synchronous serial communication protocol used for short-distance communication, primarily in embedded system.

facilities:

→ high speed, full-duplex data exchange between a master device and one one more slave devices

SPI Bus Lines: 4 key lines:

1. MOSI (Master Out Slave In)
2. MISO (Master In slave Out)
3. SCLK (Serial Clock):
4. SS/CS (Slave Select/Chip Select):

Vid-37: What is Impedance? (AC resistance)

Bangladesh Bank

Impedance is the measure of opposition that a circuit presents to passage of alternating current. Unlike pure resistance, impedance accounts for both resistive and reactive (capacitive and inductive) elements, making it a complex quantity with both magnitude and phase.

Unit: Ω.

Components: Resistance (R), Reactance (X).

$$X_C = \frac{1}{2\pi f C}$$

C → capacitance in farads

f → frequency

$$X_L = 2\pi f L$$

$$Z = \sqrt{R^2 + X^2}, \quad \theta = \arctan\left(\frac{X}{R}\right).$$

Bangladesh Bank

Vid-38: True, Reactive, Apparent & Deformed Power:

1. True Power (P):

$P = V \times I \times \cos(\phi)$ → phase angle between

2. Reactive power (Q):

$Q = V \times I \times \sin(\phi)$

3. Apparent Power (S):

$S = V \times I$

4. Deformed Power:

- Arise due to waveform distortions.

Power Triangle: Hori, Vertical, Hypotenuse
(P) (Q) (S).

Power factor $= \frac{P}{S} = \cos(\phi)$.

Bangladesh Bank

Vid-39: Controlling a BIG LED Matrix?! How to shift registers work.

Shift registers are integrated circuits that allow serial input of data and parallel output, effectively expanding the number of outputs from a microcon.

- Serial-In-parallel-Out (SIPO): bit by bit shift.
- Common types: 8 bit shift register.

vid-40: How safe is contactless payment? How does RFID & NFC work?

Bangladesh Bank

RFID → Radio Frequency Identification. wireless method, uses electromagnetic fields to identify and track tags attached to objects.

NFC → Near Field Communicat^n: A subset of RFID tech. that enables two electronic devices to communicate when they are within a few centimeters. operates 13.56 MHz

vid-41: Does a DIY Audio Crossover make sense? How Passive filters work.

Bangladesh Bank

An audio crossover is an electronic filter circuit that divides an audio signal into separate freq bands.

Passive crossovers: use passive components like resistors, capacitors, and inductors to filter freq after the signal has been amplified.

Active crossovers: process the signal before amplification using active components.

Is it easy to Create own transformer?

vid - 42:

Bangladesh Bank

A transformer is a device that transfers energy between two or more circuits through electromagnetic induction. < step up / step down.

While constructing a transf. can be an educational experience.

vid 43: Controlling Mechanical Segment Displays: RS-485 and UART Works.

Bangladesh Bank

UART (Universal Asynchronous Reciever / Transmitter)

RS - 485 Communicat^n: works ~~to~~ betwe ~~diff.~~ drivers and recievers for use in serial communicat^n. syste

- Hardware setup
- Communicat^n protocol
- Addressing display
- Data transmission.

Bangladesh Bank

Vid-44: Improving electric longboard with a CAN Bus. What can The CAN Bus do?

CAN → Controller Area Network Bus is a robust, multimaster serial communication protocol originally developed for automotive applications.

Vid-45: Building a Digital Music player with I2S? What is I2S?

I2S: Inter IC Sound: a serial communication protocol developed by Philips Semiconductor. (NXP semiconductor now)

Key features:

Bangladesh Bank

- Serial Clock (SCK): synchronizes the data transmission.
- Word Select (WS): Indicates the channel (left to right) for the audio data.
- Serial Data (SD): Carries the actual audio data.

Vid-46: Does this old Induction Motor still work? How do Asynchronous Motors work?

elements:

Stator → Stationary part

Rotor → rotating part.

Induction motors are robust and can often be restored to working condith.

Vid-47: Building a Tube Amp. does it produce better

Bangladesh Bank

While amplifiers can impart a distinctive tonal quality - often describes as "warmth" or "richness" this doesn't necessarily equate to objectively better audio quality.

Vid-48: eFuse:

→ use power bank to power circuit
→ eFuse IC → used for protection.
→ V = 4-6 V, I = 200 mA.
→ Protects from ~~overcast~~ overcurrent, overvoltage, reverse polarity and thermal events.
→ responds in microseconds, automatically reset space and cost efficient.

তথ্য অধিকার, সংকটে হাতিয়ার

Vid-49: Oscilloscope:

Bangladesh Bank

→ Vizualizes voltage and current
→ Amount of channels - 04, + bandwidth - 50MHz.
→ low-pass filter;
→ Sampling rate - Higher rate
→ 10V → 10x → 1V,
→ Scaling factor.
→ Cursor function → Rise Time.

Vid-50: TL-431:

→ A three terminal adjustable ~~pre~~ precision ~~shant~~ shunt regulator.
→ Act like a programmable Zener diode.
→ Voltage reference + Error Amplifier

তথ্য অধিকার, সংকটে হাতিয়ার

shunt regulator

→ Maintains consistent output voltage at changing input load.

→ Application: Voltage regulator, feedback control in SMPS, overvoltage and undervoltage protection.

→ Can be used as a comparator.

Vid-51: Digital Potentiometer Guid!

→ Digital Potentiometer - allowing resistance adjustment through digital signals.

→ Used for volume control, LCD brightness adjust, turning circuits programmatically.

→ I^2C or SPI protocol.

→ 8 pin IC, Resistor ladder Network, MOSFET Digital Interface.

→ Replaces manual knob to digital communication.

Bangladesh Bank

Vid - 52: Negative Voltage:

→ (OP-amps) use negative voltage.

→ Three Methods to generate Neg. Volt:

1. Charge pump circuits
2. Transformer-Based Inversion.
3. Virtual Ground Creation.

Application: in audio amplifiers, analog signal processors. and certain types of sensors.

Vid - 53: Mechanical Switch:

limitation: Wear and Tear, contact bounce, physical Constraints.

Practical Application: 1. power control, digital Logic system, user Interfaces.

Bangladesh Bank

Vid - 54: Fuse: (Traditional fuse and Resettable Fuse)

Traditional Fuses protect circuits by breaking the connection during overcurrent but must be replaced after tripping.

Resettable fuses (PPTC) automically return to normal once the fault is cleared, making them reusable and low-maintenance.

PPTC work by increasing when heated limiting current flow without permanently damaging the component.

PPTC work slower.

Vid-55: Power Factor Correction (PFC)

Bangladesh Bank

$$PF = \frac{\text{Real power}}{\text{Apparent power}}$$

PFC improves energy efficiency by aligning the current waveform with the voltage waveform.

A lower factor leads to wasted energy, increased heat and higher electric costs.

Passive PFC → Simple bt limited.
Active PFC → near-perfect, using boost converters.

তথ্য অধিকার, সংকটে

Vid-56: Color Ring Inductor

Bangladesh Bank

1. Overlooked Components:

Functionality: Color Ring inductors serve as energy storage elements in circuits, crucial for applications like filtering and voltage regulation.

While not suitable for high-precision tasks color ring inductors are indeed useful for many basic electronic projects.

Vid-57: Ground:

Bangladesh Bank

↳ Common reference point for signal.

2 type: 1. Single → ref. point for signal voltage

2. Chassis ground → connected to the physical enclosure of a device, often linked to earth ground for safety.

Importance: noise reduction, safety, preventing ground loops.

Vid-58: Motor encoder:

→ Shifts motor shaft into electric signals.

→ Incremental encoders give relative position data

absolute encoders give exact position

→ Encoders enable precise closed-loop control for accurate motor speed.

Bangladesh Bank

→ Encoders are essential in applications such as robotics, CNC machines, and automation for better motor performance

Vid-59: Surge Protection:

TVS diode (Transient Voltage Suppression diode) priced around $0.70 offer an economical means to safeguard sensitive components from transient voltage surges

→ react swiftly in nanoseconds.

→ Can protect positive and negative voltage spikes.

→ Suitable for protecting low-voltage digital circuits.

Vid - 60: I^3C

→ a modern protocol designed to supersede I^2C and SPI.

→ offers higher data rates, lower power consumption, and improved scalability compared to its predecessors.

→ ~~this feature~~ supports features like in-band interrupts and dynamic addressing, enhancing device communication.

Vid - 61: (MOSFET Amp):

→ NPN transistor, low efficiency (~20%), limited gain, audible distortion under certain loads.

Improving the Design:

- Darlington Transistor.
- MOSFET Upgrade.

Vid - 62: PLC

PLC → Programmable Logic Controller:

→ an industrial-grade digital computer designed for controlling manufacturing processes or machinery

→ PLCs are built to with withstand harsh environments are optimized for real-time control tasks.

→ use ladder logic

→ ~~work~~ can work in high temp.

→ offer real-time debugging and monitoring