# Ev charger diagram

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The popularity of electric vehicles (EVs) is increasing rapidly in India. According to a survey, the EV market in India is estimated to increase from 3 million units in 2019 to 29 million units by 2027 with a CAGR of 21.1%. As a result, demand for AC/DC chargers and smart EV chargers will also increase.

In order to charge the batteries efficiently and to ensure their long life, we need smart battery management or charging system. To realize such EV charging stations, Holtek has come up with smart Electric Vehicle Battery Charging Solutions based on their low-cost ASSP flash microcontroller (MCU) HT45F5Q-X for charging EV batteries.

At present, three EV charger designs suitable for the Indian market with specifications of 48V/4A, 48V/12A, and 48V/15A are available for rapid development of the product. This semiconductor-based smart charging system can support both lithium-ion as well as lead-acid battery types.

The Block diagram of the Electric Vehicle Battery Charging Solution is shown in Fig. 1. Here, battery charger ASSP flash MCU HT45F5Q-X is the heart of the EV charger circuit with in-built operational amplifiers (OPAs) and digital-to-analog converters (DACs) that are necessary for battery charging function.

The features and working of the EV charger solution for 48V/12A specification are briefly explained below. This EV charger design utilizes HT45F5Q-2 MCU for implementing the battery charging control function.

The MCU incorporates a battery charging module, which can be utilized for closed-loop charging control with constant voltage and constant current for efficiently charging a battery. The internal block diagram of MCU HT45F5Q-2 is shown in Fig. 3.

The battery charging module in HT45F5Q-2 has built-in OPAs and DACs that are needed for the charging process. Therefore the design reduces the need for external components like shunt regulators, OPAs, and DACs, which are commonly used in conventional battery charging circuits. As a result, the peripheral circuit is compact and simple, resulting in a smaller PCB area and a low overall cost.

Input power to the EV charger is an AC voltage in the range of 170V to 300V. The EV charger uses a half-bridge LLC resonant converter design, because of its high-power and high-efficiency characteristics, to obtain DC power for charging the battery.

The design utilizes a rectifier circuit for converting input AC voltage to high-voltage DC output, and it also has an electromagnetic interference (EMI) filter to eliminate high-frequency noise from the input power source. A pulse-width modulation (PWM) controller IC, like UC3525, can be used for driving the MOSFETs of the half-bridge LLC converter.

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The battery charging process is supervised by the MCU HT45F5Q-2. It monitors the battery voltage and charging current levels and gives feedback to the PWM controller IC. Based on the feedback, the PWM controller varies the duty cycle of its PWM signal and drives the MOSFET circuit to obtain variable output voltage and current for charging the battery.

For better protection, HT45F5Q-2 is isolated from the rest of the circuit (i.e. high-voltage components) using a photo-coupler. Battery-level LED indicators are provided for knowing the charging status.

The change in charging voltage and current during the charging process is graphically illustrated in Fig. 4. If the battery voltage is too low when connected for charging, low charging current (i.e. trickle charge (TC)) will be set initially, and the charging process will start.

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