Automated EMI Testing System

Hardware Description
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Overview

The Automated EMI Testing System is a system used to measure the near field EMI emissions of a chip at precise locations. The system is made up of two smaller subsystems: a probe connected to an amplifier to measure the near field strength at any given position and a stepper motor controlled XY-table that positions the device under test (DUT) at each of the desired testing locations. Both subsystems are tied together by a computer that assigns tasks to both systems

Hardware Description

Measurement Subsystem

The measurement subsystem is relatively straight forward; every element has at most one input location and one output. The components of the system were chosen based on both the performance of the individual piece as well as the ability to repeat results at other EMI testing facilities. The probe and amplifier are both 1:1 matches to other testing sites.

The probe is a Langer RF-B 0,3-3 H-Field Probe. It's designed to take near field EMI amplitude measurements at close ranges to the chip while vertically opposed (in contrast to directional measurements taken with horizontally opposed probes). Its signal is then amplified by a Miteq

AM-1622-2500 amplifier. The Miteq was chosen due to its bandwidth, which covers all of the important bands for cellphone communication between 30 MHz and 2.5 GHz with an amplification flatness of less than 2 dB. The Langer probe screws directly into the Miteq amplifier, which is then connected via a SMA to BNC cable an Agilent E4403B Spectrum Analyzer.

The spectrum analyzer was chosen due to its ability to cover the frequency rangfe required for the near field EMI testing as well as its GPIB interface, which allows the data measured by the subsystem to be transferred over to a computer for deeper analysis.

Movement Subsystem

The movement subsystem is made up of five modules. A CY8CKIT-001 provides the PSoC 1 microcontroller module, as well as a module for an LCD screen used to display messages about the internal workings of the microcontroller and a module for RS232 communication that converts COM port commands into UART commands usable by the microcontroller. The PSoC then communicates with stepper motor modules (one for each axis direction) that control the movement of an XY table to position the DUT accordingly.

Input to the microcontroller comes from the COM port of a nearby PC. Commands are sent with the relative positioning coordinates of the next measurement location. These coordinates are then converted into

pulses to be sent to the “Step” pin on the EasyDriver Stepper Motor Driver V4.3, as well as a logic level sent to the “Direction” pin. The number of steps required to move the XY table by the desired amount is fed into a counter. The counter is used to count the number of pulses sent by the pulse width modulator (PWM). The output of the counter is inverted and fed back into the enable “pin” of the PWM, so that when both systems are started at the beginning of a move, the counter output asserts to false, which is inverted to true and used to enable the PWM. The PWM continues to pulse until the number of pulses sent reaches the set number, causing the counter output to assert true, which then disables the PWM and triggers an interrupt. The interrupt stops the PWM and counter and resets them. The system could be controlled entirely by the interrupt, but competing interrupts as well as software delays would introduce error into the system by allowing the PWM to run longer than intended. By connecting the output of the counter to the enable of the PWM, the movement is stopped immediately as the PWM reaches its final pulse.

Each pulse of the “Step” pin rotates the stepper motor .225 degrees, allowing for precise positioning. The EasyDriver Stepper Motor Driver achieves such small increments by a process called “microstepping”. Microstepping alternates pulses between two stators at a ratio that holds the shaft in between the two possible angles. A full step of the stepper motors is 1.8 degrees.

The UART/RS232 module converts the two pin UART communication into a format usable by a computer COM port. The LCD module accepts signals from the PSoC and displays messages that are sent while the system operates, updating the user on the actions occurring within the chip.