

ANALYSIS AND DESIGN OF AN ESP8266-BASED 3-PHASE SMART CONTACTOR

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ABSTRACT

The operation of 3-phase contactors in industry is generally still carried out manually and often causes electromagnetic noise as well as the risk of arcing. This study proposes the design and construction of an internet of things (IoT)-based 3-phase smart contactor system using solid state relay (SSR) to replace conventional mechanical contactor. The system hardware consists of NodeMCU ESP8266 as the main controller, an Android application based on MIT App Inventor, and Google Firebase for remote control. The system is also equipped with push button via AC to DC optocoupler modules for local manual control options. Testing was conducted on a load of three units of 3-phase induction electromotors (one 1 HP unit and two 1/2 HP units) using direct on line (DOL) and parallel circuit configurations. The test results show that the smart contactor successfully operates electric motors safely and stably below the nominal nameplate limits. The average load voltage ranges from 377.3 V to 383.3 V. Load testing on three electromotors produces starting currents of 1.793 A (DOL 1 HP Motor), 0.503 A (Parallel 1/2 HP Motor 1), and 0.92 A (Parallel 1/2 HP Motor 2), as well as running currents of 1.72 A, 0.463 A, and 0.726 A, respectively. In the on response time test, manual control (0.58 seconds) is faster than the application (1.33 seconds) with a transmission delay of 0.75 seconds, whereas in the off condition, application control is more responsive (0.76 seconds) compared to manual control (0.86 seconds). Voltage variation testing (380 V – 400 V) and application triggering reliability over 100 repeated trials yielded a 100 % success rate without miss-trigger. Although conventional contactors are slightly superior in pure mechanical response speed (a difference of on 0.19 seconds and off 0.11 seconds), the smart contactor is capable of maintaining equivalent electrical characteristics, operating silently (silent), without arcing risks, and retaining auxiliary terminal functions NO/NC.

Keywords: Smart Contactor, Solid State Relay, MIT App Inventor, Google Firebase, Conventional Contactor.