To Upgrade Weld Inspection Unit For Resistor Manufacturing

[1]Priya Charles, [2]Apurva Jannawar, [3]Akshay Wagh, [4]Nisha Ubale

[1,2,3,4]Department of Electronics and telecommunication, SPPU, Dr. D. Y. Patil Institute of Engineering, Management and Research, Akurdi, pune

Email: [1]prinnu@yahoo.com, [2]apurvajannawar@gmail.com, [3]nishakubale55@gmail.com, [4]akshaywagh.212@gmail.com

ABSTRACT ; Assurances for the weld quality are the use of technological methods and jobs to test or guarantee the quality of welds, and secondarily to confirm the presence, location and coverage of welds. During manufacturing, welding is done to affix two or more metal surfaces. Because these connections may come up against loads and fatigue during product lifetime, there is a chances that they may fail if not created to proper specification.

Goal of the welding inspection is to guarantee the welding quality of the wire relative to the cap for the customers of resistors. Welding quality guarantee concerns that every weld satisfies fixed definitions. In former days the welding quality was regularly checked manually. The wires were bent up and down relative to the resistor body.

On this method regularly bad welded resistors are delivered to the customers. Many problems concerning welding cracks take place with automatic placement of resistors on printed card boards.

On occasion of these problems a 100% inspection on the welding machine had to be found. The answer on this is electrical welding inspection. Our endeavour is to upgrade the existing weld inspection unit by PLC and HMI.

Keywords: - Welding, Quality, Breakdown time.

I. INTRODUCTION

Monitoring methods for weld are required to guarantee the quality and correctness of the weld during the process of welding. The term weld inspection is generally applied to automated monitoring for weldquality purposes and secondarily for process-control purposes. To ensure good quality weldingit is important to have a quality weld inspection program in place. In order to do so a manufacturer must understand how to evaluate weld characteristics, determine the quality of weld and have a welding inspector capable of performing a number of different testing methods. Weld quality is inspected for the number of reasons, the most fundamental of which is to determine whether its quality is good enough for its intended application. Weld quality acceptance criteria can originate from number of sources.

To assess the quality of weld it is necessary to have form of measurement. Weld inspection unit is the part of Camel Machine used for manufacturing of resistors. Weld inspection unit checks the quality of the welding done at the cap of the resistors that comes from back-end process. The drawings of welding fabrication or a blue prints provides weld sizes and other welding dimensions such as length and location of welding. These dimensions are required for design point of view.

In the current weld inspection unit, there are five PCBs working for the welding and quality inspection of welding. Those five PCBs are named as

1. Pulse PCB
2. Right PCB
3. Left PCB
4. Shift PCB
5. Indication PCB

Due to use of these PCB's on which discrete components are mounted the fault finding and its diagnosis was complicated. As we have to test each and every component on the PCBs, this leads to increase i:n the breakdown time.

So, we are trying to replace those PCBs with PLC and hence there is increase in the performance of weld inspection unit. By using PLC, the weld inspection unit becomes highly efficient to test the quality of welding done in the resistors.

Components: GOT (Graphical Operational Terminal), HMI (Human Machine Interface), PLC (Mitsubishi FX3U).

II. METHOD AND MATERIAL

This section lists the hardware components and software that would be used in implementing the proposed system. The **Proteus Design Suite** is an Electronic Device Automation (EDA) tool that includes schematic capture, simulation and PCB Layout modules. GX Developer-FX is a compressed version of the currently available SW5D5C-GPPW-E from Mitsubishi Electric, and it is designed as a programming tool for the Mitsubishi programmable controller FX series. GX Developer-FX includes all of the functionality provided by the full GX Developer software package, but is limited to those required when using an FX series PLC.

Hardware Identified

- PLC (FX3U)
- HMI (GOT 2110 WTBD)
- LEDs
- LCD
- ADC (FX2N 8AD)

Software Identified:

- Proteus
- GX developer
- GT designer

Block Diagram

A **block diagram** showing in schematic form the general arrangement of the parts or components of a complex system or process, such as an industrial apparatus or an electronic circuit. In this section we have described each block of the entire system in detail with their specifications.

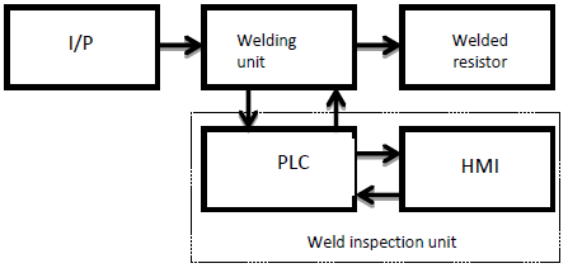

Fig. 1

To the welding unit, capped resistors are fed as the input. The weld unit welds the terminals of both side of the resistor. This is done by using PLC and HMI. In this project the PCB's at the weld inspection unit are replaced by PLC and HMI.

- Capped Resistors:-

After the sputtering and lacquering process, the resistors are capped. After the capping process the capped resistors are sent for welding. Welding is done using camel machine.

- Welding unit:-

Welding is done using camel machine. At initial stage there will be a mechanical pressure developed between wire and cap (for wire diameter 0.6 about 2.8 kg). If that much of pressure is available then the command "welding" will be given.

This occurs by means of a VSO- switch, which is attached to the cam shaft. A current flow (about 1000 A) during a short time of about 8ms. This current flows through welding chuck from the wire to the cap afterwards through the welding wheel and the welding strip back to the welding transformer. At the place of highest contact resistance the temperature will be highest. If this temperature is above 800 degree centigrade, according to the available pressure, the wire will be welded. According to the melt-off, the chuck transfers in direction of the cap. On a fixed distance to the welding chuck arm an electrical detector (proximity switch) is placed, which converts the mechanical movement of the arm into an electrical voltage.

- Weld inspection unit:-

Basically there are three important positions at the welding unit which are inspected electrically.

1. Zero Level.:- The zero level will be measured as the wire depressed against the cap (before welding). This zero level may vary from +200um to -200um in respect of the electrical zero.

2. Melt Off.:- The melt-off is the difference which is measured between zero level and the displacement of the chuck as a result of the welding (melt-off).The melt-off length depends on welding pressure + welding voltage.

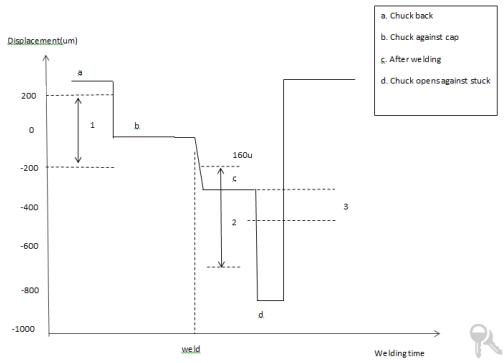

Fig. 2

This graph is plotted between displacement and welding unit. The graph indicates that when a product is present in the welding wheel and lead to be welded is pressed against the product then the welding cycle is at level b.

Principle Operation:-

Wire displacement limits:-

- Left hand weld:- 180um-500um
- Right hand weld:-180um-500um

The signal is directly proportional to the displacement compared to the reference level.

If signal is within the above limits the weld is correct.

If the level exceeds upper limit then the detector counts one reject.

If the level is lower than the lower limit then detector counts one reject.

Machine stops when:-

- More than 5 successive product are rejected.
- Product indexing wheel is blocked.

- Wire or Product is not present.
- Machine not properly adjusted.

III. COMPONENT SELECTION

FX3U PLC

Fig. 3

Sr. No.	Specifications	FX3U
1.	Part number	FX3U - 48 MR – ES
2.	Manufacturer	Mitsubishi
3.	No. of inputs	24
4.	No. of outputs	24
5.	Supply voltage	100-240 VAC
6.	Height	90 mm
7.	Width	182 mm
8.	Depth	86 mm
9.	Weight	0.85 kg
10.	Step Program memory	64000

Other Features:-

- Compact and expandable PLC.
- Available as both AC or DC powered.
- Can be expanded for up to 384 input/outputs.
- Consists of three integrated pulse inputs.
- LEDs for indicating input and output.
- Integrated serial interfaces.
- A 2nd RS485/232/422 communication interface can be added.
- Slot for memory cassettes.
- Integrated real time clock.
- Integrated positioning clock.

HMI- GOT2110 WTBD

Fig. 4

The GOT carries on to impress with solutions that fulfil all demands. The GOT2000 provides advanced functionality, acts as a seamless gateway to other industrial automation devices, all while increasing productivity and efficiency.

Sr. No.	Specifications	HMI 2110
1.	Part number	GS 2110 WTBD
2.	Size	10.4”
3.	Pixels	800 X 480
4.	Type	TFT
5.	Voltage	24 V DC
6.	Screen	65k Color
7.	Backlight	LED
8.	Keyboard	Touch screen
9.	Color	Black
10.	Internal memory	9 MB
11.	Height	214 mm
12.	Width	272 mm
13.	Weight	1.3 kg
14.	Depth	56 mm
15.	IP rating (front)	IP65
16.	IP rating (back)	IP20

FX2N 8AD ADC

Fig. 5

The FX2N-xAD module with analog input is used to convert the analog input into a digital value of 12 bits, and to provide the converted values of ADC to the PLC controller.

FX2N-xAD can be connected with FX0N, FX2N, and the FX2NC series Programmable controllers.

Sr. No.	Specifications	FX2N 8AD
1.	Module type	Input/Output
2.	Input type	Analogue
3.	Output type	Digital
4.	No. of inputs	8
5.	No. of outputs	8
6.	Voltage category	24V DC
7.	Length	105mm
8.	Width	75mm
9.	Depth	75mm
10.	Dimensions	105x75x75mm

IV. FLOWCHART

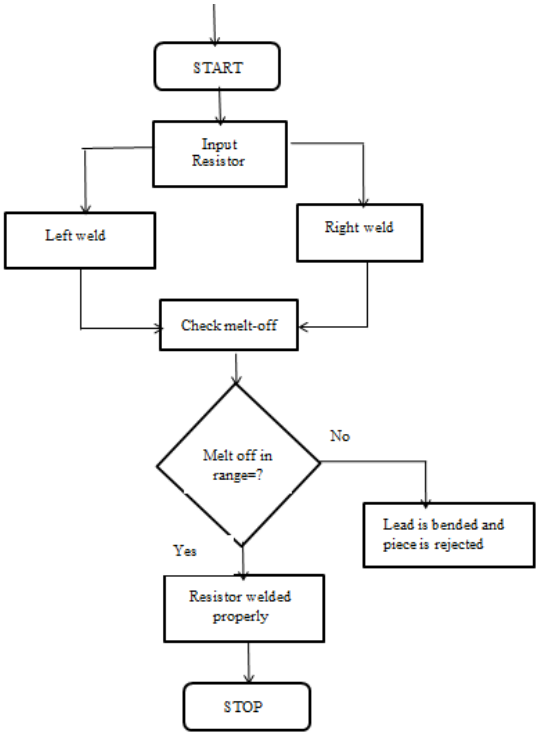

Fig. 6

V. SOFTWARE DESCRIPTION

- **Proteus Design Suite**

The **Proteus Design Suite** is an Electronic Design Automation (EDA) tool which includes schematic capture, simulation and PCB Layout modules. The Proteus Design Suite is an application of Windows for schematic capture, simulation, and PCB layout design. It can be purchased in many configurations, depending on the size of designs which are being produced and the requirements for microcontroller simulation. All PCB Design products consist of an auto router and basic mixed mode SPICE simulation capabilities. The simulation of microcontroller in Proteus works by providing either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it Schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design phase of a PCB layout project. It is therefore a core component and is contained with all product configurations.

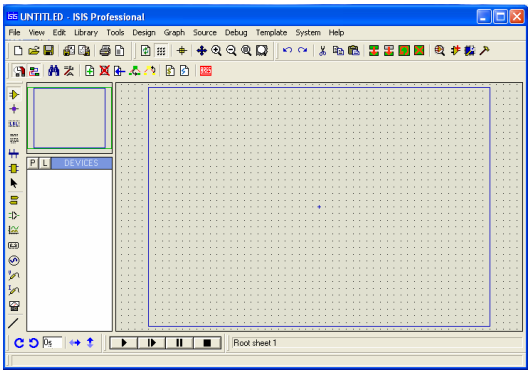

Fig. 7

- **GX Developer**

The **GX-DEVELOPER- FX** is effortless programming software that supports the entire PLC range. It is a cost effective cut down version of GX developer, specifically designed to support the micro FX PLCs. GX developer supports all MELSEC controllers ranging from the compact PLCs of the MELSEC FX series to the advanced PLCs including MELSEC System Q. This software gleams with a simple, intuitive interface and a short learning curve. GX Developer supports the different PLC programming languages including the MELSEC instruction list (IL), MELSEC ladder diagram (LD) and MELSEC sequential function chart languages. You can switch back and forth between IL and LD as per the choice while you are working. You can program your own function blocks (MELSEC QnA/QnAS/System Q series), and a wide range of features are available for configuring special function modules for the MELSEC System Q. The package consists of the powerful editors and diagnostics functions for configuring your MELSEC networks and hardware, and extensive testing and analysing functions.

- It is a Standard programming software for all MELSEC PLCs
- It has Comfortable prompting under Microsoft Windows
- It supports Ladder diagram, instruction list or sequential function chart
- It is changeable during operation
- It supports offline simulation for all PLC types
- No hardware needed

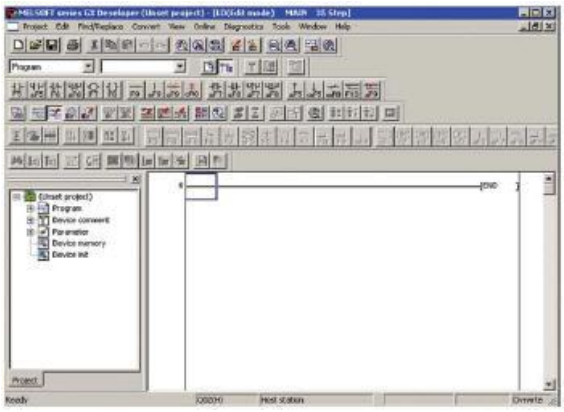

Fig. 8

- **GT Designer**

GT Designer is a software program which is used to construct HMI screens for the entire line of Mitsubishi Electric GOTs. It is a screen design software. It is a user friendly Windows environment of the GT designer which provides a simple and identifiable interface, facilitating a quick learning curve for new users.GT Works3 is the design and configuration software for the GOT1000 and GOT2000 Series of HMIs. This complete and instinctive design environment provides host of attributes and graphical elements required to rapidly and easily develop visualization projects. Data entry fields, dialogue windows even placement aids have been optimized to lessen the development time and provide the flexibility that every programmer demands. After screen development is completed, one touch simulation allows developers to debug and verify their projects using real-time variables and conditions.

Fig. 9

VI. ADVANTAGES

- By using PLC and HMI fault finding and diagnosis becomes simpler.
- It is reprogrammable, so it does not require any changes in the internal hardware.
- Breakdown time is also reduced.

IV. CONCLUSION

The growth in electronic market has resulted to a great demand for fast and accurate production of passive electronic components. In this project the PCBs and discrete components are replaced by PLC and HMI. Therefore the maintenance cost of the unit is reduced. In the present system if any component on the PCB fails then it used to affect the overall production. The discrete components are obscelance thereby difficult to get it. Thus by using PLC the rejection ratio is decreased increasing the productivity of the system. As HMI is used, good interface can be provided to control the machine. Faults can be easily detected and corrected.

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