HIGH POWER TRANSMITTER MONITORING & CONTROL USING GSM

Imran A Tailor[1], Kalpesh A Patel[2], FarukMd Z Rathod[3]

[1, 2, 3]Department of Electronics & Communication, Government Engineering College, Bharuch – 392 002
External guide: - ShriAnurag Bhatia, Internal guide: - Prof. Sandip J. Dawda, Gujarat Technological University, Gujarat, India.

Abstract

***W**ireless Communication is being one of the modern trends of communication which is mostly nowadays implemented everywhere. Likewise, Doordarshan HPT Vadodara is having a manual Control and Monitoring of transmitter parameters like Forward & Reflected power, Temperature IN and OUT, Air Blower, Individual Power Amplifiers Data. So looking to this we have defined this as one of the Industrial defined problems. Based on this, the analysis of manual control is carried out theoretically & practically. Depending on this analysis the implementation of automatic control is to be implemented using wireless communication through GSM at HPT, Vadodara after successful design of control circuit.*

Key words: *High Power Transmitter, PIC Motherboard, Digital Temperature sensor (DS18B20), GSM Modem, Smoke detector*

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1. INTRODUCTION

We had three week summer training at Doordarshan HPT Vadodara. During our training we had noticed many problems occurring in Transmitters. Due to these problems broadcasting was interrupted many times. These problems were solved manually by the technicians of HPT. Also the officials of HPT Vadodara have to take the Readings of Thomcast Transmitter in the slots of one hour continuously. This requires continuous monitoring of Thomcast Transmitter. Hence the Problem defined is: There is no Automatic Fault Detection and Solution for the Fault occurrences in the Thomcast Transmitter of ~217MHz at Doordarshan HPT Vadodara. This article consists of Solution of the Defined Problem. Following parameters of Thomcast transmitter are manually monitored

1 Manual & Local Monitoring Forward and Reflected Power
2 Manual & Local Monitoring of Temperature IN & OUT
3 Manual & Local Monitoring of Air Blowers
4 Lack of Fire Alert System

1.1. Manual & Local Monitoring of Forward and Reflected Power:-

Forward Power is the power which passes through the waveguide, up towards the antenna and is radiated into the atmosphere. Reflected power is the power which is being reflected back due to impedance mismatch. Impedance discontinuities cause attenuation, attenuation distortion, standing waves, ringing and other effects. Even a slight amount of reflected power can damage the inbuilt circuitry of power amplifiers. Hence forward and reflected power has to be monitored & control continuously which is presently done manually at HPT Vadodara. This Problem of manually Monitoring and Control can cause Human error and also there has to be Technician appointed for this purpose which causes loss of time and money for an industry.

1.2. Manual & Local Monitoring of Temperature IN & OUT

Low-power transmitters do not require special cooling equipment. Modern transmitters can be incredibly efficient, with efficiencies exceeding 98 percent. However, a broadcast transmitter with a megawatt power stage transferring 98% of that into the antenna can also be viewed as a 20 kilowatt electric heater. Thomcast transmitter is maintained at 26-34 Degree Celsius. Transmitter is protected against excess temperature increase. For an air inlet temperature exceeding 45 C, the output power is reduced to avoid downgrading amplification chain reliability. If the temperature at air outlet exceeds 60 C the transmitter is shut down. Also increase in temperature can damage the inbuilt circuitry of transmitter. Hence Temperature In and Out has to be monitored & controlled continuously which is presently done manually at HPT.

1.3. Manual & Local Monitoring of Air Blowers

The purpose of Air Blowers is to remove heat and dirt from transmitter. Failure in Air Blower operation can give rise to increase in temperature. Hence Air Blowers has to be

monitored & controlled continuously which is presently done manually at HPT.

1.4. Lack of Fire Alert System

As we know that Electronic equipments are always exhausting heat from them. Hence there is much probability of having Fire. During our visits at HPT we had noticed in availability of Fire alert system in the Transmitter room. Hence Fire alert system will be implemented by us.

2. SOLUTION FOR THE DEFINED PROBLEM

Below figure shows the block diagram of our project. The Microcontroller which we are going to use is PIC16F887. These Microcontroller is different from normal microcontroller as it has inbuilt Multiplexer & A/D converter. A small sample of Forward & Reflected is available from Directional Coupler. This Signal being analog signal is going to be very weak. Hence Forward and Reflected power (analog signals) will be directly given to Peak Detector circuit. The beautiful feature of PIC motherboard avoids conversion of these analog signals to digital externally.

The Temperature sensor which we are going to use is DS18B20 Digital temperature sensor. Hence the Digital output will be directly given to the PIC Microcontroller. As far as Blowers are concerned there is a switch indicating the operation of it. A closed switch indicates one bit while an open switch indicates a zero bit. Hence this Digital data will be given to the PIC Microcontroller.

PIC Motherboard is directly interfaced to GSM Modem. Now if any of the parameters are going beyond the limit then message will be sent to the concerned officials of Doordarshan HPT, Vadodara via GSM Modem

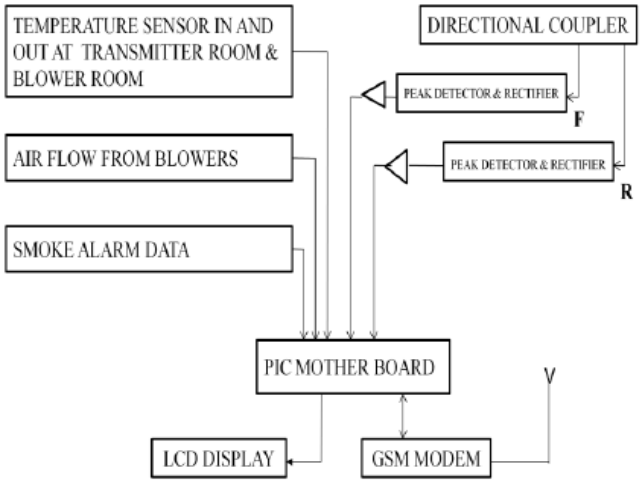

Fig-1: (Block diagram of Monitoring & Control of Transmitter using GSM)

3. FLOW CHART OF MONITORING HIGH POWER TRANSMITTER

Below diagram shows the flow chart of Temperature Monitoring. As soon as PIC Motherboard is turned ON first Temperature will be displayed on LCD through Microcontroller. Now if the temperature is greater than 40·C then a message will be forwarded to the officials of Doordarshan. Also we had kept the system of Miscall. According to it the microcontroller continuously reads GSM Modem. If there is any miscall on the GSM Modem than the number will be stored in microcontrollers memory. After that whatever the Temperature might be it will be forwarded in the form of message to that number.

Case of Forward & Reflected power is much similar. If the Reflected power is greater than 100w or if the Forward power is less than 9kw then a message will be forwarded to the officials of Doordarshan. Also we had kept the same system of Miscall here also. According to it if there is any miscall on the GSM Modem than whatever the Reading of Power might be it will be forwarded in the form of message to that number.

Hence the parameters of Thomcast transmitter will be easily monitored.

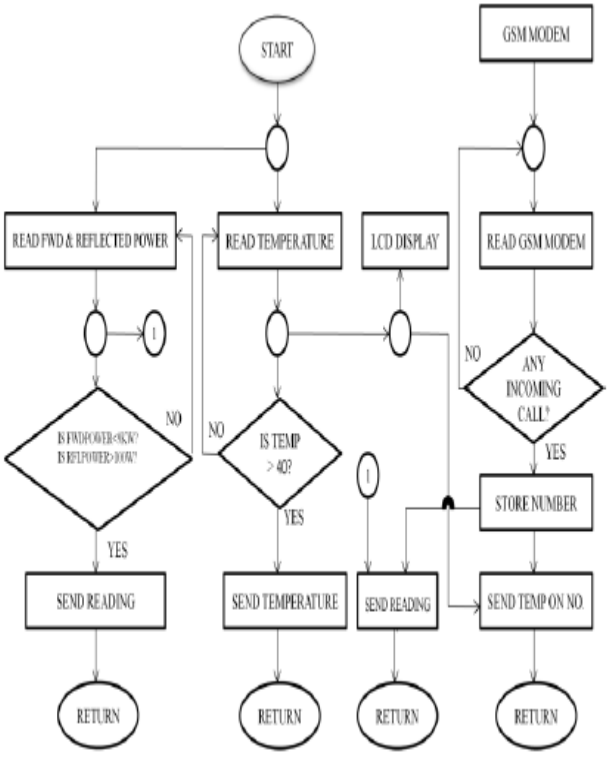

Fig-2: (Flow chart of Monitoring of Transmitter using GSM)

3.1 Monitoring Temperature of High Power Transmitter:-

The beautiful feature of Temperature Sensor by directly giving the Digital output has reduced much of work in interfacing with PIC Microcontroller. As shown in the figure DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. It has an operating temperature range of -55°C to +125°C and is accurate to ±0.5°C over the range of -10°C to +85°C. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply.

Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area. Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems.

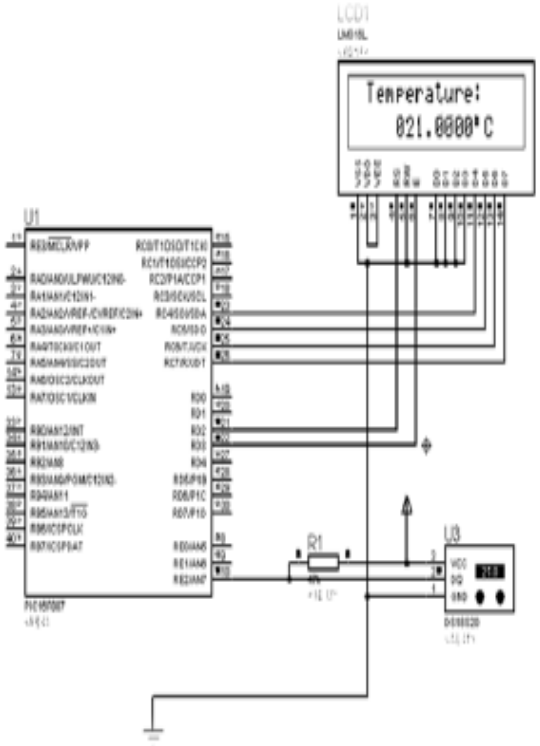

Fig-3: (Interfacing of DS18B20 with PIC Mother Board)

3.2Monitoring smoke status of Transmitter Room:-

Smoke sensor which we are going to use is Digital smoke sensor. Hence its operation is similar to temperature sensor.

3.3Monitoring Forward & Reflected Power of High Power Transmitter

(a) Peak detector circuit for Forward & Reflected Power

A peak detector is an electronic circuit that is commonly used for measuring the power in signals. In tape, floppy disk and hard disk systems, peak detectors are employed to recover the recorded information by detecting the peak voltages in there play signal and generating a square wave that corresponds to the stored binary sequence.

A peak detector works by differentiating the incoming signal and producing a zero at the peak position of the incoming signal. The output of the differentiator is then fed into a zero-crossing detector which acts as a bit analogue-to-digital converter and generates a square wave. The edges of the square wave will coincide with the peak positions of the incoming signal.

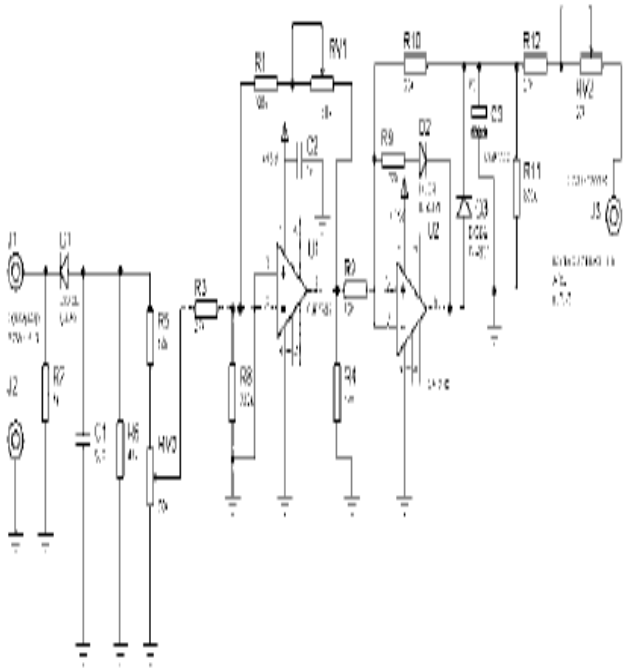

Fig-4: (Peak detector circuit for Forward Power)

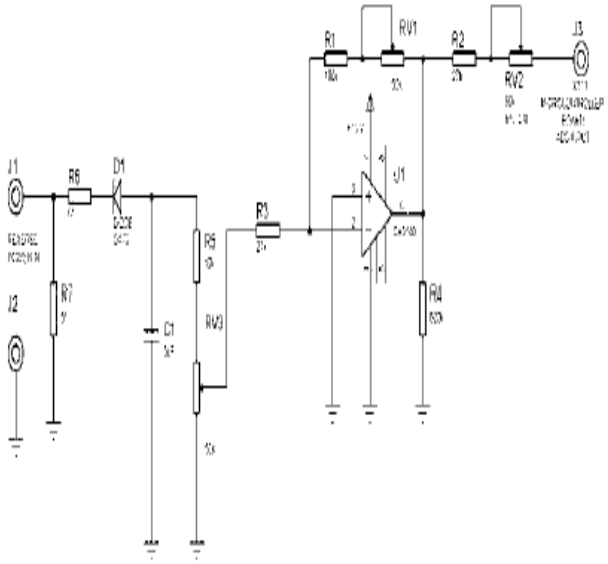

Fig-5: (Peak detector circuit for Reflected Power)

Below figure shows interfacing for forward & reflected power. At Doordarshan, Vadodara a small sample of signal is available from directional coupler. Now this small signal will be given to peak detector circuit. The outputs of peak detector is scaled between 0 to 10 kW for forward power and 0to 100W for reflected power. During simulation in software we had represented a battery as a peak detector o/p to the microcontroller.

Method of scaling for Forward power:-

Power = (long) adc_value * 10;
Power = power/ 1023;

Above equation is working as follows. As an example consider the output from peak detector as 5V. Now this 5V is represented as 1023 bits in the first step which is multiplied by 10. In the second step the first step answer is divided by 1023 which results an output of 10kW.

Method of scaling for Reflected power:-

Power = (long) adc_value * 100;
Power = power/ 1023; above equation is working as follows.

As an example consider the output from peak detector as 5V. Now this 5V is represented as 1023 bits in the first step which is multiplied by 100. In the second step the first step answer is divided by 1023 which results an output of 100W.

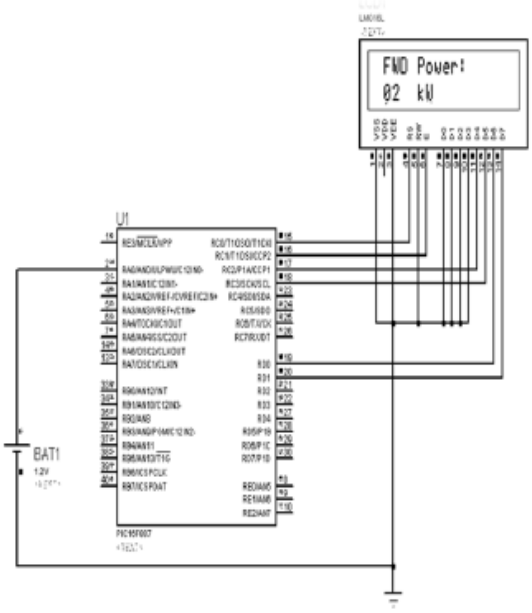

Fig-6: (Interfacing of Forward & Reflected Power with PIC Mother Board)

4. CONTROL OF HIGH POWER TRANSMITTER

Thomcast transmitters had a Temperature limit of 40·C and output forward power as 10kw. Now if any of the parameters are going above the limit then at the first a message of "Temperature High" or "Power Low" will be first displayed on LCD and after than Transmitter will be Trip off. Transmitter will be turned ON only after reset of PIC microcontroller. Transmitter will be trip off with the help OFF relay circuit.

Below figure shows the above described condition. In the simulation software we had represented an LED indicating the fault in temperature or forward power.

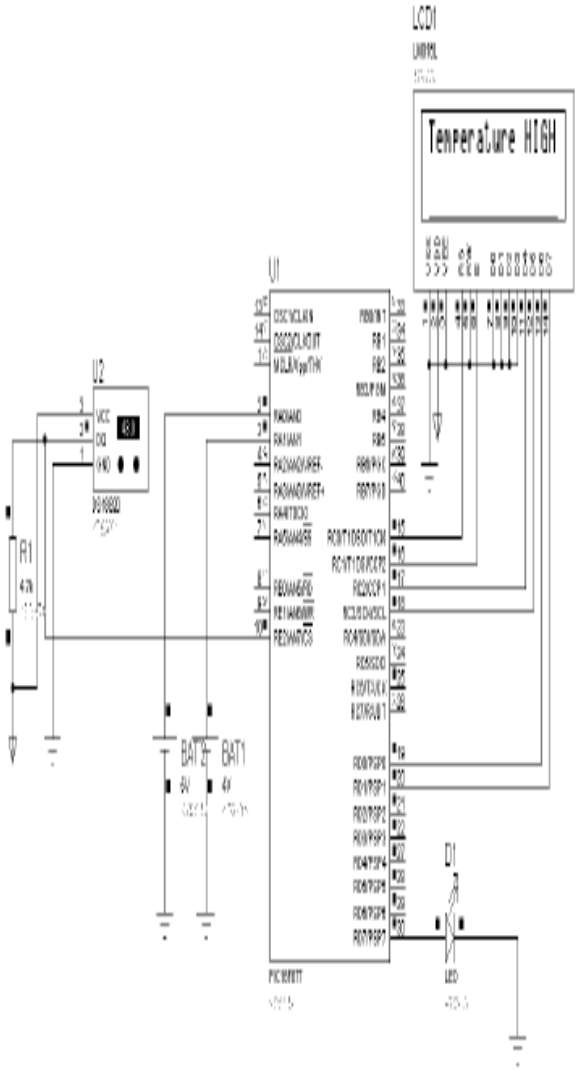

Fig-7: (condition when Temperature is HIGH)

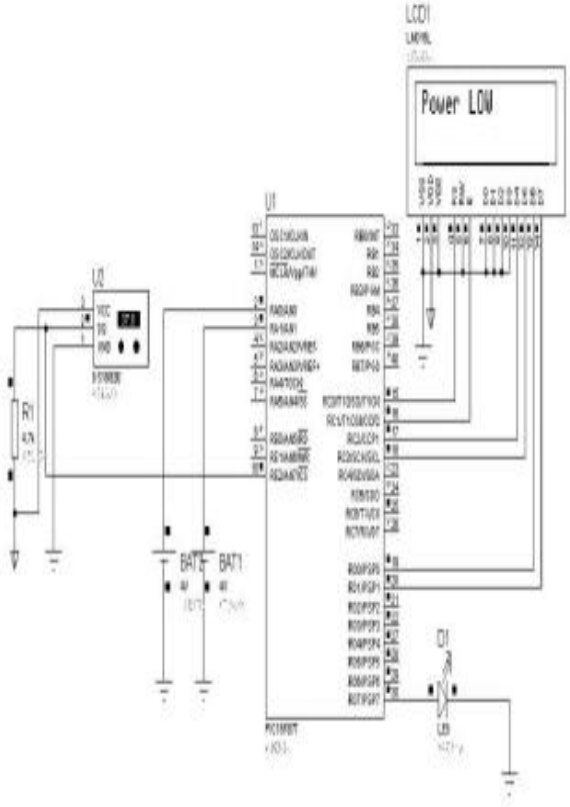

Fig-8: (condition when Power is LOW)

CONCLUSIONS

This Paper illustrates application of Wireless Communication in the form of High Power Transmitter Monitoring & Control using GSM which has significantly reduced the errors which were occurring during manual monitoring.

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BIOGRAPHIES

ShriAnurag Bhatia received his BSC physics Degree from APS University, Rewa and AMIETE from New Delhi. He has been as Engineering Assistant of DMC Vadodara from 2006.

Sandip J. Dawda (sandip_dawda@yahoo.co.in**)** received his M.E. Degree from L. D. College of Engineering. From April 2011, he has been a faculty member of Electronics & Communication Engineering in Government Engineering College, Bharuch, Gujarat, India. His areas of interests are in Wireless Communication, Data Communication & Networking, and Digital Communication.

Kalpesh A. Patel (kalpeshpatel23_1991**)** is pursuing B.E. Electronics & Communication Engineering from GEC, Bharuch and presently he is working on his project under guidance of ShriAnurag Bhatia and Professor Sandip J. Dawda.

Imran A. Tailor (tailorimran3@gmail.com**)** is pursuing B.E. Electronics & Communication Engineering from GEC, Bharuch and presently he is working on his project under guidance of ShriAnurag Bhatia and Professor Sandip J. Dawda.

FarukMd Z. Rathod (rathodfaruk48@gmail.com**)** is pursuing B.E. Electronics & Communication Engineering from GEC, Bharuch and presently he is working on his project under guidance of ShriAnurag Bhatia and Professor Sandip J. Dawda.