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# Development of PC based transient current analysis system using microcontroller and Hall effect sensor

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**Abstract —** In electrical power system transient condition occur during transformer switching, motor starting or during fault conditions. Therefore, the accurate measurement of transient current is a critical input to protection relays which monitor the current and / or voltage signals to determine whether the monitored portion is faulted and should be isolated, or whether conditions are normal and should remain closed to maintain the flow of power. If protection relays receive the "true" representation of current flowing on a transmission line, or into transformers, capacitor banks, or reactor banks, they will make decisions based on the current that is actually flowing, not based on a distorted representation of the current which the relay may need to compensate for. An undistorted view could improve the ability of the relay to trip when it should and to prevent false trips.

**Keywords —** Transient current, Current analysis system, Microcontroller, Hall effect, Hall effect sensor, PC with RS232 port, Transient.

**Introduction —** A transient event is a short – lived burst of energy in a system caused by sudden change of state. In electrical engineering, oscillation is an effect caused by a transient response of a circuit or system. It is a momentary event preceding the steady state (electronics) during a sudden change of circuit. Mathematically, it can be modeled as a damped harmonic oscillator. Transient current is an oscillatory or a periodic current that flows in a circuit for a short time following an electromagnetic disturbance.

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input / output peripherals. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory and input/output devices, microcontrollers make it economical to digitally control even more device and processes.

The Hall Effect is the production of a voltage difference across an electrical conductor, transverse to an electric current in the conductor and a magnetic field perpendicular to the current. It was discovered by Edwin Hall in 1879.

A Hall effect sensor is a transducer that varies its output voltage in response to a magnetic field. Hall effect sensors are used for proximity switching, positioning, speed detection, and current sensing applications. In its simplest form, the sensor operates as an analog transducer, directly returning a voltage. With a known magnetic filed, its distance from the Hall plate can be determined.

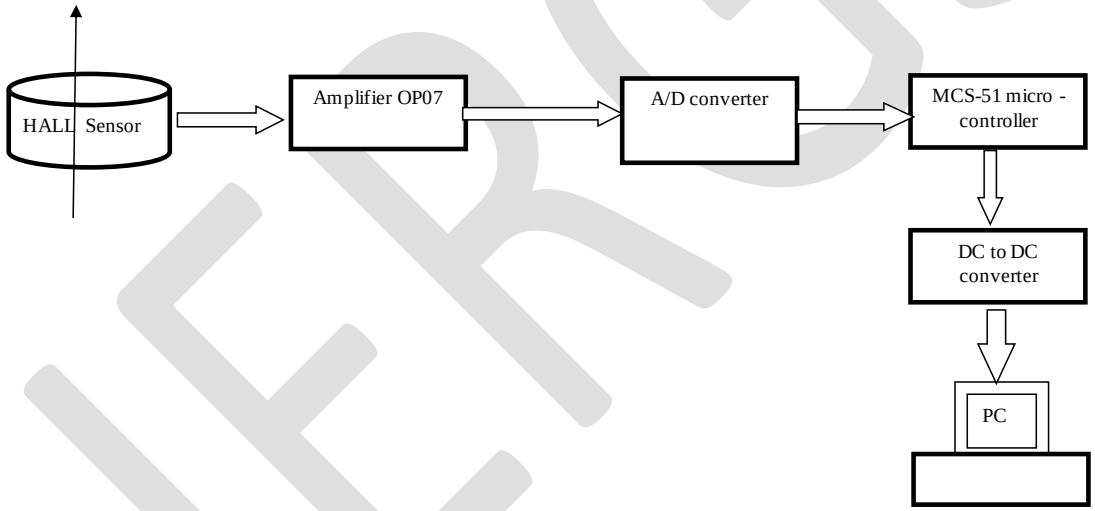
A Hall effect sensor may operate as an electronic switch.

- Such a switch costs less than a mechanical switch and is much more reliable.
- It can be operated up to 100 kHz.
- It will not be affected by environmental conterminal since the sensor is in a sealed package. Therefore it can be used under severe conditions.

Hall effect sensors provide much lower measuring accuracy than fluxgate magnetometers or magneto resistance based sensors. Moreover, Hall effect sensors drift significantly, requiring compensation.

**Methodology —** The procedure involved the following steps :-

- Developed PC based software for current analysis.
- Developed interface between Hall effect sensor and microcontroller.
- Captured transient data in PC via microcontroller and Hall effect transducer using serial port RS 232.




**Hardware and Software used**

- Hall Effect Transducers – CSNE151
- A/D Converter – ADC 0804
- Microcontroller – MCS51 family - 89C51 ( 8 bit, 32 I/O)
- DC-DC converter – MAX232C
- PC with RS232 serial port
- Software Programme – Visual Basic (VB6.0)
- Backend Database – MS Access/Excel

**Results & Discussions —**

| No. | Primary Current (Amps) | Hall Output (Peak to Peak mV) | Cycle RMS (mV) | Frequency (HZ) | Load in WATT | Remarks |
|---|---|---|---|---|---|---|
| 1. | 1.6 | 100 | 35 | 50.20 | 500 | Lamp Load |
| 2. | 1.9 | 146 | 51.99 | 50.00 | 800 | Lamp Load |

**Hall Sensor Specification :**

Nominal Primary Current : 36A

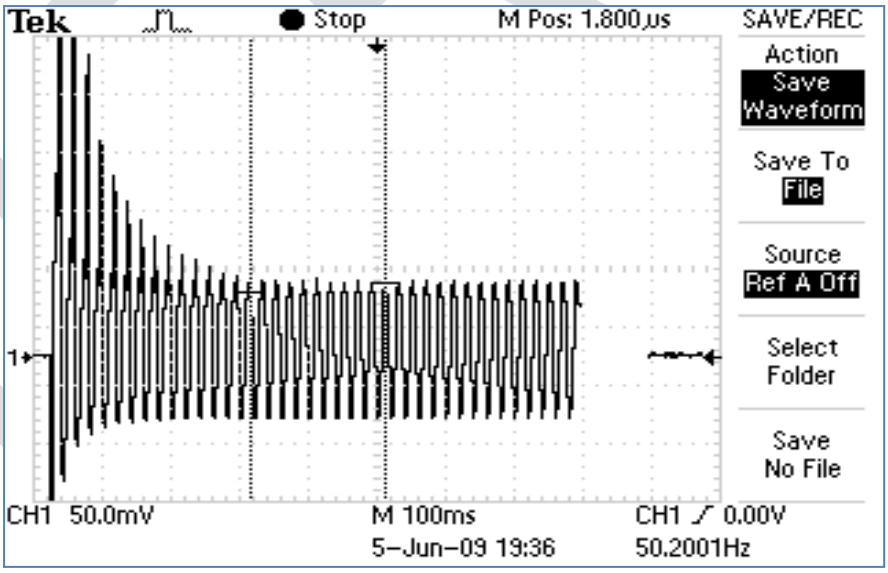
Nominal Output Current : 25mA

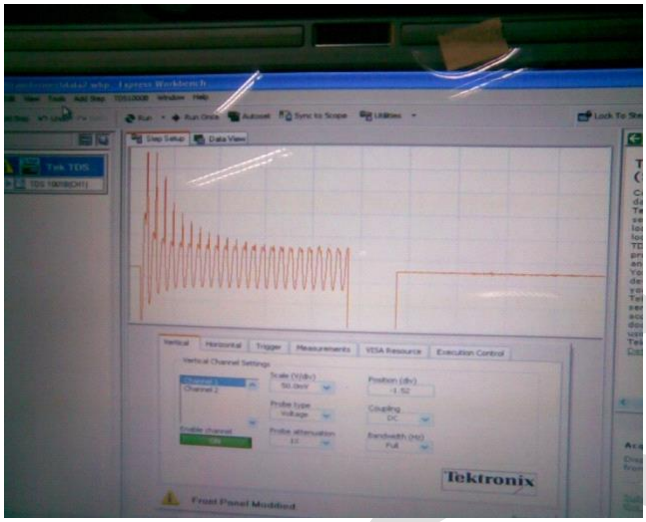
Measuring Range : 0 to 36A

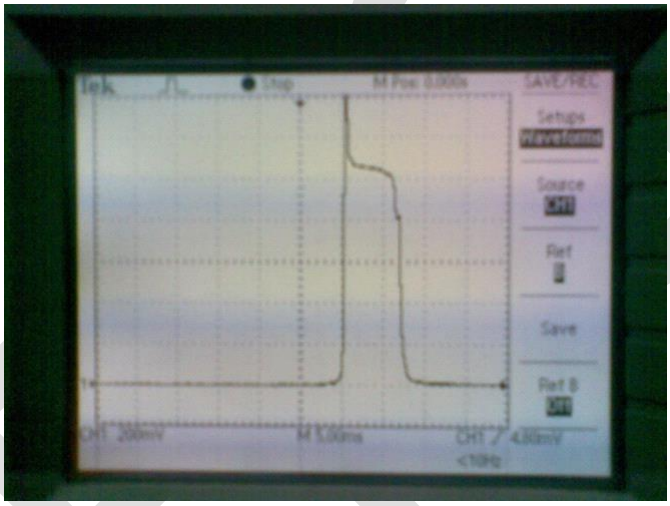
Load Resistance : 190 Ohm

Supply Voltage : +/- 15 V

Waveforms :






**Program – Transmitting serial data from microcontroller**

```
org 00 ; Source program starts with 00 address
                clr P2.0 ;
                NOP
                Set B P2.0
                MOV th1, # 253 ; Load TH1 with preset value
                MOV tl1, # 253 ; starting count = preset value
                MOV TMOD, # 20H ; Set Timer in auto Reload mode
                MOV SCON, # 40H ; mode,9600,N,8,1
                SET B TR1          ; start timer
   L1:          MOV SBUFF,P1    ; load data in Sbuf for transmission
   HERE:        JNB t1; here
                clr Tr1
                SJUMP L1
```

**Program – Reading serial data in PC**

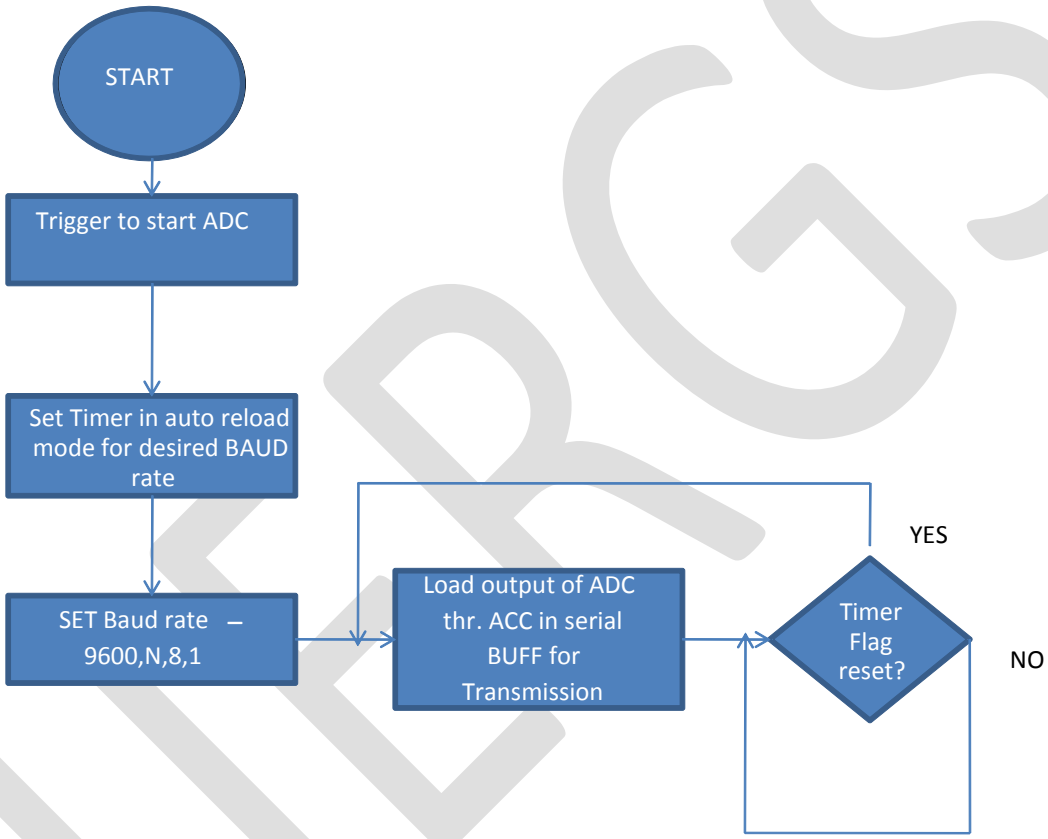
MSCOMM1.COMMPOST = 2 ; SET THE PORT NO

MSCOMM1.SETTINGS = "9600,N,8,1" ; SET UART PARAMETERS

MSCOMM1.PORT0PEN = TRUE

BUFFER$ = BUFFER$ & MSCOMM1.INPUT :READ DATA

**Flowchart**




**Conclusion** — Hall effect sensor CSNE151 has been used which is apparently considered to be suitable for the project due to its higher band width (DC-150kHZ). Conventional current sensor has not been considered due to its low bandwidth. I have measured transformer inrush current using Hall effect current transducer.

CSNE151 sensor is suitable for 415V system. Maximum voltage it can withstand is 5 KV. The maximum current rating available is 1200A. So, we need to explore more about suitability of Hall sensor for high power high voltage application.

The sampling rate is approx. 1000 samples/data per sec. If baud rate can be improved the data will be more accurate.

This waveform can be analyzed to find out the actual harmonic content using FT or WEBLET. Hence, nature of over current can be distinguished and accordingly an intelligent protection system can be made. Possibility of using this Hall sensor in high voltage system needs to be explored.

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