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College Of Engineering

Communication Engineering Department

DESIGN AND IMPLEMENTATION OF A THERMAL DATA ACQUISITION FOR TELEMETRY SATELLITE SYSTEM

A project

Submitted to the Department of Communication University of Diyala-College of Engineering in Partial Fulfillment of the Requirement for Degree Bachelor in Communication Engineering

BY

HallaNasrat

MarwaQassim

Supervised by

Dr. Riyadh Khalaf

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بِسْمِ اللهِ الرَّحْمنِ الرَّحِيمِ

إِنَّ فِي خَلْقِ السَّمَوَاتِ وَالْأَرْضِ وَاخْتِلَافِ اللَّيْلِ وَالنَّهَارِ وَالْفُلْكِ الَّتِي تَجْرِي
فِي الْبَحْرِ بِمَا يَنْفَعُ النَّاسَ وَمَا أَنْزَلَ اللَّهُ مِنَ السَّمَاءِ مِنْ مَاءٍ فَأَحْيَا بِهِ الْأَرْضَ
بَعْدَ مَوْتِهَا وَبَثَّ فِيهَا مِنْ كُلِّ دَابَّةٍ وَتَصْرِيفِ الرِّيَاحِ وَالسَّحَابِ الْمُسَخَّرِ
بَيْنَ السَّمَاءِ وَالْأَرْضِ لَآيَاتٍ لِقَوْمٍ يَعْقِلُونَ (164)

صدق الله العلي العظيم

سورة البقرة

Dedication

TO

MY " FAMILY " WITH LOVE

Acknowledgement

We wish to thank our family for theirunderstanding and support including our parents, siblings, our big family and our friends inside and outside university.

We wish to express our deepest gratitude to our Advisor Dr. Riyadh K. Ahmed for his guidance and friendship during our study. And at last we want to thank the department of communication for giving us the chance to work on as a fine project as this one.

ABSTRACT

In the last few decades remote sensing has reached from an experimental to an operational level. The increase in the number of earth observation satellites, the advancement in tools and processing techniques, and the use of data for new applications has been phenomenal. However, the major part of the efforts were directed in the past towards the use of telemetry data and now also to the use of microwave data. The design and implementation of thermal data acquisition for telemetry satellite system was experimentally simulated by using sensor type LM35 and ADC 0804 with 8-bit was used as a unipolar configuration. The system is efficient, simple, low cost and reliable for high speed data acquisition.

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LIST OF ABBREVIATIONS

ADC – Analog to digital converter

ADQ– Data acquisition

LIST OF SYMBOLS

TC	_	Temperature
Vout	_	Voltage of output
Vin	_	Voltage of input
Vref	_	Reffrance Voltage
LSB	_	Leas significant bit in the analo-to-digital conversion process
MSB	_	Most significant bit D7 of register to 1, with all ather bit to 0

CHAPTER ONE

INTRODUCTION

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1.1 Introduction

A satellite communications system is a complex system that consists of manydifferent elements. The system requires the constant attention of many skilledpeople in order to remain operational.A typical system can be divided into three distinct segments).The ground segment (GS) consists of the earth stations and other groundbased facilities used for communications traffic. With some systems, such as with the global positioning system (GPS), broadcasting satellite service (BSS) systems — also called direct broadcasting service (DBS), very small aperture terminal (VSAT) networks, and some military satellites, earth stations consist entirely of user terminals that interface directly with the space segment. In this case, the ground segment may be called the user segment(US).The space segment (SS) consists of one or more satellites in space,including both active and spare satellites. A group of active satellites is said to form a constellation. The launch vehicle and all of the facilities required to launch satellites and place them in orbit are also considered part of the space segment[1] .The control segment (CS) includes all of the ground equipment andfacilities that are required for operation, control, monitoring and managementofthe space segment and, in many systems, management of the terrestrialnetwork. Communications satellites offer several important advantages over other types oflong-range communications systems: the capability of direct communicationbetween two points on earthwith only one intermediate relay (the satellite), theability to broadcast or collect signals and data to or from any area ranging up tothe entire surface of the world, and the ability to provide services to remoteregions where ground-based, point-to-point communications would be impracticalor impossible.One of the greatest advantages of satellite communications systems is the ratioof capacity versus cost. Although satellites are expensive to develop, launch andmaintain, their tremendous capacity makes them very attractive for manyapplications. INTELSAT I, launched in 1965, had a capacity of only 240 twowaytelephone channels or one two-way television channel, and an annual cost of$32 500 per channel. Since then, the capacity and lifetime of communicationsatellites have increased tremendously resulting in a drastic reduction in the costper channel. Communications satellites now have capacities sufficient for severalhundred video channels or tens of thousands of voice or data links[2].In addition to applications designed specifically for communications purposes,satellites are used extensively for navigation systems, scientific research,mapping, remote sensing, military reconnaissance, disaster detection andreliefandfor many other applications. All of these applications, however, require atleastone communications link between the satellite and one or more earthstations.The Satellite Communications Training System is a state-of-the-art trainingsystem for the field of satellite communications. Specifically designed for handson training, the system covers modesatellitecommunication technologiesincluding analog and digital modulation. It is designed to use realistic satelliteuplink and downlink frequencies at safe power levels and to reflect the standardscommonly used in modern satellite communications systems. The Orbit Simulator provides interactive visualization of satellite orbitalmechanics and coverage, and the theory behind antenna alignment withgeostationary satellites. The optional Dish Antenna and Accessories provideshanks-on experience in aligning a typical antenna with real geostationarysatellites.

1.2 Analog to digital converter

Analog to digital converters is electronic integrated circuit which transforms a signal from analog (continuous) to digital (discrete) form. Analog signals are directly measurable quantities. Digital signals only have two states. For digital computer, we refer to binary states, 0 and 1. Microprocessors can only perform complex processing on digitized signals.When signals are in digital form they are less susceptible to the deleterious effects of additive noise.ADC Provides a link between the analog world of transducers and the digital world of signal processing and data handling. ADC are used virtually everywhere where an analog signal has to be processed, stored, or transported in digital form. Some examples of ADC usage are digital voltmeters, cell phone, thermocouples, and digital oscilloscope.Microcontrollers commonly use 8, 10, 12, or 16 bit ADCs, our micro controller uses an 8 or 10 bit ADC.the type of ADC are Dual Slope A/D Converter,Successive Approximation A/D Converter,Flash A/D Converter,Delta-Sigma A/D Converter and Other[3].

1.3 Thermal sensor

Temperature is a useful measure of the thermodynamic state of an object or system. It is a macroscopic description of the aggregate amount of microscopic kinetic energy in a material. If two bodies are at the same temperature, they are in thermodynamic equilibrium with each other; if they were connected to each other, there is no net flow of heat from one to the other.Interestingly, temperature is not a measure of the unit thermodynamic energy of a body; unit masses of differing materials can require differing amounts of energy to be added or removed to change their temperature by a given amount. Identical temperature of two bodies merely implies there would be no transfer of heat between the two, regardless of the actual energy stored as heat in each body.

1.4 Problem Statement

The satellite system send special data about satellite status known as telemetry protocol. telemetry protocol consist of a set of rules to show the satellite status such as DC motor ,solar cell, and earth sensor .All the reading was converting to voltage so as to the ground station can read the satellite status in digital form by using analog to digital convertor

1.5 Objectives

The objective of the project is study,design and implementation of a thermalacquisition for satellite system. The implementation system based on analog digital converter.

1.6 Organization of research

Chapter one deals with the introduction of the satellite communication system, the ADC which transforms a signal from analog (continuous) to digital (discrete) form , the temperature sensors that converts a physical phenomenon into a measurable electrical signal, the problem statement and the aim of the research. .

Chapter two deals with the literature review of some researches in thermal data acquisition where the researchers work to develop the telemetry satellite system.

Chapter three deals withdesign and implementation of the system. The use of LM35Precision Centigrade Temperature Sensors as precision integrated-circuit temperature .sensors, whose output voltage is linearly proportional to the .Celsius (Centigrade) temperature. Analog to digital converter type 8-bit, AD 0804 was used to convert the analog voltage to digital value

Chapter four shows the results of the thermal sensor calibration that corresponding to output voltage where the slope of voltage reading is 10 mv/c. The reading of ADC was tabulated to show the final reading of the temperature. The system isvery important to know some information about the satellite statues such as location altitude solar cell ,earth sensor ,solar sensor ,and so on .so we need collect the reading of all sensor as telemetry data.

The chapter five deals with Conclusion and Future work.

2.1 Introduction

The function of an analog-to-digital converter is to produce a digital word which represents the magnitude of some analog voltage or current. The following are some specifications of an Analog-to-digital converter. There are two ways to best improve the accuracy of A/Dconversion :increasing the resolution which improves the accuracy in measuring the amplitude of the analog signal .increasing the sampling rate which increases the maximum frequency that can be measured The size, type and gain of the receiver, transmitters and antennas used depend mainly on the type of mission the spacecraft is designed to accomplish. There are two main types of missions dealing with communications: near Earth communication and long range data relay. The receivers and transmitters consist of several parts. The key components in receivers and transmitters are amplifiers, filters and demodulator. .The amplifiers and filters are combined into a single unit.

We list below some of related research in field of thermal sensor, data acquisition ,and telemetry protocol.

2.2 Design Elements of Satellite Telemetry, Tracking and Control Subsystems for the Proposed Nigerian Made Satellite

Felix N. C. Anyaegbunam. Department of Physics/Geology/Geophysics, Federal University, Ndufu-Alike-Ikwo, Abakaliki.

Proved the indispensability of Telemetry, Tracking and Control (TT&C) as the brain and operating system of all Satellite or Spacecraft missions is well known. The Centre for Satellite Technology Development (CSTD) in Nigeria has recently initiated a SPIRE (Satellites to Promote Instructional and Research Experiments) program desired to develop and test an engineering model of a micro-satellite as a precursor to the proposed[4] indigenous development and launch of made in Nigeria Satellite. This paper reviews the essential elements necessary for the design and implementation of

TT&C, the important component of the proposed Satellite subsystem. The basic components, design overview, programming procedure of TT&C subsystems are presented, while the functions and relationships between various subsystems are highlighted.

2.3 Telemetry, Tracking and Commandingsubsystem for the CzechTechSat Pico satellite

Ning YangMaster of Science in Space Science and Technology. Czech Technical University.

He explained the main goal of his work is to perform research, design, development and summary of achieved results of the Telemetry, Tracking and Commanding (TT&C) subsystem for the Czech Tech Sat Cube Sat-class pico satellite . Consider different types of RF components,amplifiers, low noise preamplifiers, commercial telemetry modules and power consumption with respect to price, availability, reliability and simplicity of assembly. During design period the influence of the near-space and space environment shall be considered to gather with possible influence of ionizing and particle radiation background. Consider and implement the most convenient TT&C frequency plan for satellite communication allowed by the International Telecommunication Union (ITU). Determine the expected and width with respect to real environment of the stratospheric balloon light and LowEarth Orbit (LEO) space light. Implement simple data transfer protocol. Summarize the test and achieved results .MarlenneAngulo, Marco A. Turrubiartes proved This paperpresents a telemetry subsystem of anano-satellite. It is based on ADF7020 development kit form modulation and AT91SAM3U4-EK as on-board computer .The presented prototype could be used for educational purposes, considering Cube sat standard. The telemetry system by its nature, can use variousdigital modulation schemes, considering that the more complex the scheme it requires more transmission power to maintain the signal to noise ratio required by the receiver subsystem [4].

2.4 Implementation of Computer and Telemetry Subsystems Link, on a Nano-Satellite System

MuktiZainuddin Proceedings of the World Congress on Engineering and Computer Science 2012 Vol IIWCECS 2012, October 24-26, 2012, San Francisco, USA.

He explained theTo understand better and describe oceanic hot spots for albacore (Thunnusalalunga), we linked remotely sensed data from multi-sensor satellite images of TRMM/TMI sea-surface temperature (SST), Sea WiFs chlorophyll-a concentration and photo synthetically active radiation (PAR), and AVISO mean sea-level anomaly (MSLA) with fisheries catch data from 1998 to 2003. A probability map was generated based on biophysical environmental variables (SST and chlorophyll-a) in relation to the catch data. The probability of environmental variables was combined with an eddy kinetic

energy (EKE) map to describe the oceanographic features around fishing locations. Primary production was examined to assess the productivity of the fishing grounds and was calculated from chlorophyll-a, SST and PAR using the vertically generalized production model (VGPM). Results indicate that the greatest catches occurred mainly in November, and the catches were highest at warm SSTs (19.7871.691C) and relatively high chlorophyll-a concentrations (0.3170.13 mgm_3). Highest catches occurred in areas where primary production rates ranged from 15.65 to 20.61 gCm_2 month_1 (18.1274.98 gCm_2 month_1). Our analysis found that catch per unit efforts (CPUEs) tended to increase significantly in areas of increasing probability of environmental variables (Po0.0001) during the season of high abundance. Albacore CPUEs were clearly higher during November 1998–2000 than during November 2002–2003. During 1998–2000, the congregating spots of albacore clearly showed that the probability and primary productivity rates were higher than during 2002–2003. It is likely that the area of high probability (preferred biophysical environmental factors) corresponds to the location of frontal zones, where albacore prey were abundant[5].

2.5 Estimating evapotranspiration of European forests from NOAA-imagery at satellite overpass time: Towards an operational processing chain for integrated optical and thermal sensor data products

Garner, Gerald **W** Department of Astronomy, University Leuven (K.U.Leuven).

He showed that The U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game have cooperated since 1984 to develop and evaluate satellite telemetry as a means of overcoming the high costs and logistical problems of conventional VHF (very high frequency) radio-telemetry systems. Detailed locational and behavioral data on caribou (Rangifertarandus), polar bears (Ursusmaritimus), and other large mammals in Alaska have been obtained using the Argos Data Collection and Location System (DCLS). The Argos system, a cooperative project of the Centre National d'EtudesSpatiales of France, the National Oceanic and Atmospheric Administration, and the National Aeronautics and Space Administration, is designed to acquire environmental data on a routine basis from anywhere on earth. Transmitters weighing 1.6-2.0 kg and functioning approximately 12-18 months operated on a frequency of 401.650 MHz. Signals from the transmitters were received by Argos DCLS instruments aboard two Tiros-N weather satellites in sun-synchronous, near-polar orbits. Data from the satellites were received at tracking stations, transferred to processing centers in Maryland and France, and made available to users via computer tape, printouts, or telephone links. During 1985 and 1986, more than 25,000 locations and an additional 28,000 sets of sensor data (transmitter temperature and short-term and long-term indices of animal activity) were acquired for caribou and polar bears. Locations were calculated from the Doppler shift in the transmitted signal as the satellite approached and then moved away from the transmitter. The mean location error for transmitters at known locations (n = 1,265) was 829 m; 90% of the calculated locations were within 1,700 m of the true location.

2.6 Using multi-sensor satellite remote sensing and catch data to detect ocean hot spots for albacore (Thunnusalalunga) in the northwestern North Pacific.

Stephen leatherwood laboratory of Marine Bioresource and Environment Sensing, Graduate School of Fisheries Sciences, Hokkaido University.,

He explainedthe test of a satellite Platform Transmitter Terminal (PTT) in the laboratory (on a float and on captive seals) and on a free-ranging harbor seal in the Southern California Bight to investigate the utility of satellite telemetry in documenting seals ’at-sea behavior and movements. They used records from a microprocessor-based time-depth recorder (TDR) to interpret location and diving records from the PTT. For the free-ranging harbor seal, we obtained at least one uplink during 70% (while the seal was at sea) to 82% (while she was ashore) of satellite passes and at least one location each day. Of 62 locations determined by Service Argos for the free-ranging seal, 20 were verified from TDR records to have been at sea; these indicated that the seal may have ranged up to 48 km from the haul-out site, although most locations were within 5 km. The accuracies of locations calculated when the seal was at sea (±15 km) were substantially less than when it was ashore (±1.5 km), thus limiting at-sea tracking of seals by satellite to rather gross movements. Fewer transmissions were detected and locations calculated when the seal was actively diving than when it was swimming near the surface as it departed from or returned to the haul-out site. Consequently, average dive durations indicated by the PTT were substantially shorter than those calculated from TDR records. Documentation of foraging areas and detailed at-sea movements using satellite technology may not be possible for pennies unless PTT-transmission rates are increased substantially from the 1 per 45 set maximum rate now permitted by Service Argos.

2.7 Satellite Telemetry, Tracking and Control Subsystems

Christopher J. O'NeillUniversity College, Department of Physics and Astronomy, Gower Street, London WC1E 6BT, England.

He explained the remote monitoring of animal behavior in the environment can assist in managing both the animal and its environmental impact. GPS collars which record animal locations with high temporal frequency allow researchers to monitor both animal behavior and interactions with the environment. These ground-based sensors can be combined with remotely-sensed satellite images to understand animal-landscape interactions. The key to combining these technologies is communication methods such as wireless sensor networks (WSNs). We explore this concept using a case-study from an extensive cattle enterprise in northern Australia and demonstrate the potential for combining GPS collars and satellite images in a WSN to monitor behavioral preferences and social behavior of cattle[6].

2.8 Principles of Satellite Communications

David R. WaltUniversity of Bristol, Department of Nuclear Physics.

Heproved the measurement of low-level dissolved CO_2 using a fiber-optic sensor is described. The sensor, based on the Severing haus CO_2 electrode principle, consists of a CO_2-sensitive bicarbonate buffer solution containing the pH-sensitive fluorescent dye carboxy-SNAFL-1 immobilized at the end of an optical fiber using a gas-permeable membrane. The sensor is used in a ratio metric mode and has a reversible working dynamic range between 200 and 1000 pm CO_2 and a sensitivity ±1 pm. Results are presented for the sensor calibration, effects of temperature, and response time characteristics. An integrated measurement system with electro optic and data acquisition modules coupled to a satellite transmission system was tested in Vineyard

Sound, MA, and data are presented that demonstrate continuous monitoring of pCO_2 in surface seawater.

3.1 Thermal data acquisition

Data acquisition (DAQ) is the process of measuring an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound with a computer.A data acquisition system consists of many components that are integrated to:Sensor, Condition the electrical signal to make it read able by an A/D board, Convert the signal into a digital format acceptable by a computer and Process, analyze, store, and display the acquired data with the help of software .Data acquisition and control hardware generally performs one or moreof the following functions:

Figure (3.1) shows the block diagram of a thermal data acquisition. It consists of analog input,analog output, digital input,digital output and counter time[7].

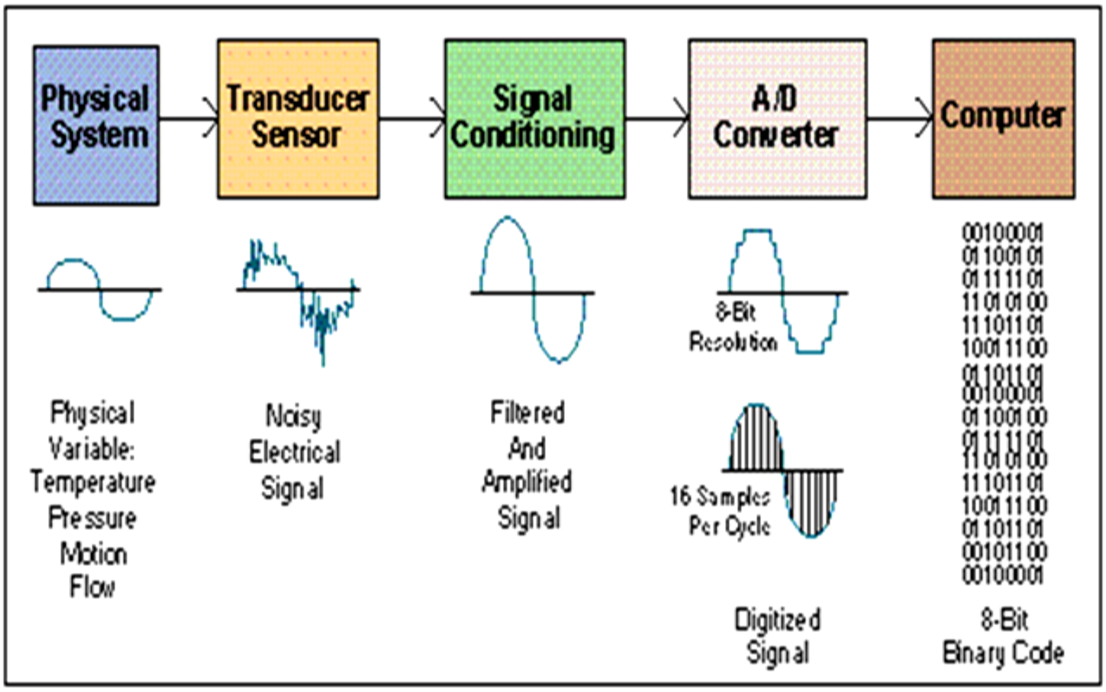


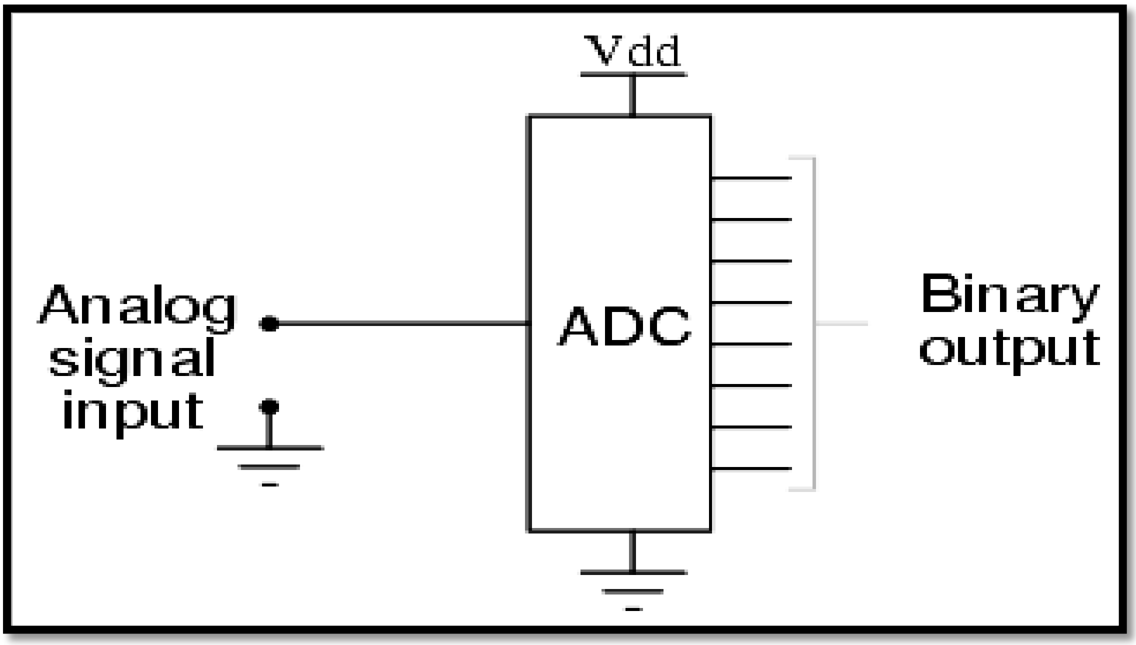
Figure (3.1). Block Diagram of Data Acquisition System

3.2 Telemetry systems

Measure physical properties from afar such as Status of spacecraft resources, health, attitude, and operation; Scientific data; Spacecraft orbit and timing data for ground navigation; Images; Tracked object location; Relayed data .In ADC the converter, and it is Highly automated communications process by which data are collected from instruments located at remote or inaccessible points and transmitted to receiving equipment for measurement, monitoring, display, and recording. The science and technology of automatic measurement and transmission of data by wire, radio, or other means from remote sources, as from space vehicles, to receiving stations for recording and analysis .The recent progress in electronics and telecommunications has made remote telemetry systems very reliable and cost effective for use in water quality monitor.

3.3 Analog to digital converter

ADCan electronic integrated circuit which transforms a signal from analog (continuous) to digital (discrete) form. Analog signals are directly measurable quantities. Digital signals only have two states. For digital computer, we refer to binary states, 0 and 1.When signals are in digital form they are less susceptible to the deleterious effects ofadditivenoise.ADC Provides a link between the analog world of transducers and the digital world of signal processing and data handling ADC are used virtually everywhere where an analog signal has to be processed, stored, or transported in digital form .Some examples of ADC usage are digital volt meters, cell phone. Figure(3.2)shows the circuit of ADC.



Figure(3.2).The block of ADC

3.3.1 ADC type 0804

Analog to digital converters find huge application as an intermediate device to convert the signals from analog to digital form. These digital signals are used for further processing by the digital processors. Various sensors like temperature, pressure, force etc. convert the physical characteristics into electrical signals that are analog in nature.

ADC0804 is a very commonly used 8-bit analog to digital convertor. It is a single channel IC, *i.e.*, it can take only one analog signal as input. The digital outputs vary from 0 to a maximum of 255. The step size can be adjusted by setting the reference voltage at pin9. When this pin is not connected, the default reference voltage is the operating voltage, *i.e.*, Vcc. The step size at 5V is 19.53mV (5V/255), *i.e.*, for every 19.53mV rise in the analog input, the output varies by 1 unit. To set a particular voltage level as the reference value, this pin is connected to half the voltage. For example, to set a reference of 4V (Vref), pin9 is connected to 2V (Vref/2), thereby reducing the step size to 15.62mV (4V/255).

ADC0804 needs a clock to operate. The time taken to convert the analog value to digital value is dependent on this clock source. An external clock can be given at the Clock IN pin. ADC 0804 also has an inbuilt clock which can be used in absence of external clock. A suitable RC circuit is connected between the Clock IN and Clock R pins to use the internal clock.

All voltages are measured with respect to GND, unless otherwise specified. The separate AGND point should always be wired to the DGND ,being careful to avoid ground loops. For VIN(-) ≥ VIN(+) the digital output code will be 0000 0000. Two on-chip diodes are tied to each analog input (see Block Diagram) which will forward conduct for analog input voltages one diode drop below ground or one diode drop greater than the V+ supply. Be careful, during testing at low V+ levels (4.5V), as high level analog inputs (5V) can cause this input diode to conduct - especially at elevated temperatures, and cause errors for analog inputs near full scale. As long as the analog VIN does not exceed the supply voltage by more than 50mV, the output code will

be correct. To achieve an absolute 0V to 5V input voltage range will therefore require a minimum supply voltage of 4.950V over temperature variations, initial tolerance and loading. With V+ = 6V, the digital logic interfaces are no longer TTL compatible.

5. With an asynchronous start pulse, up to 8 clock periods may be required before the internal clock phases are proper to start the conversion process. The CS input is assumed to bracket the WR strobe input so that timing is dependent on the WR pulse width. An arbitrarily wide pulse width will hold the converter in a reset mode and the start of conversion is initiated by the low to high transition of the WR pulse (see Timing Diagrams).CLK IN (pin 4) is the input of a Schmitt trigger circuit and is therefore specified separately .None of these A/Ds requires a zero-adjust. However, if an all zero code is desired for an analog input other than 0V, or if a narrow full scale span exists(for example: 0.5V to 4V full scale) the VIN(-) input can be adjusted to achieve this. See the Zero Error description in this data sheet[8]. In figure below show the ester for the A/D. Figure (3.3) shows the set up for ADC design using AD 0804[9].

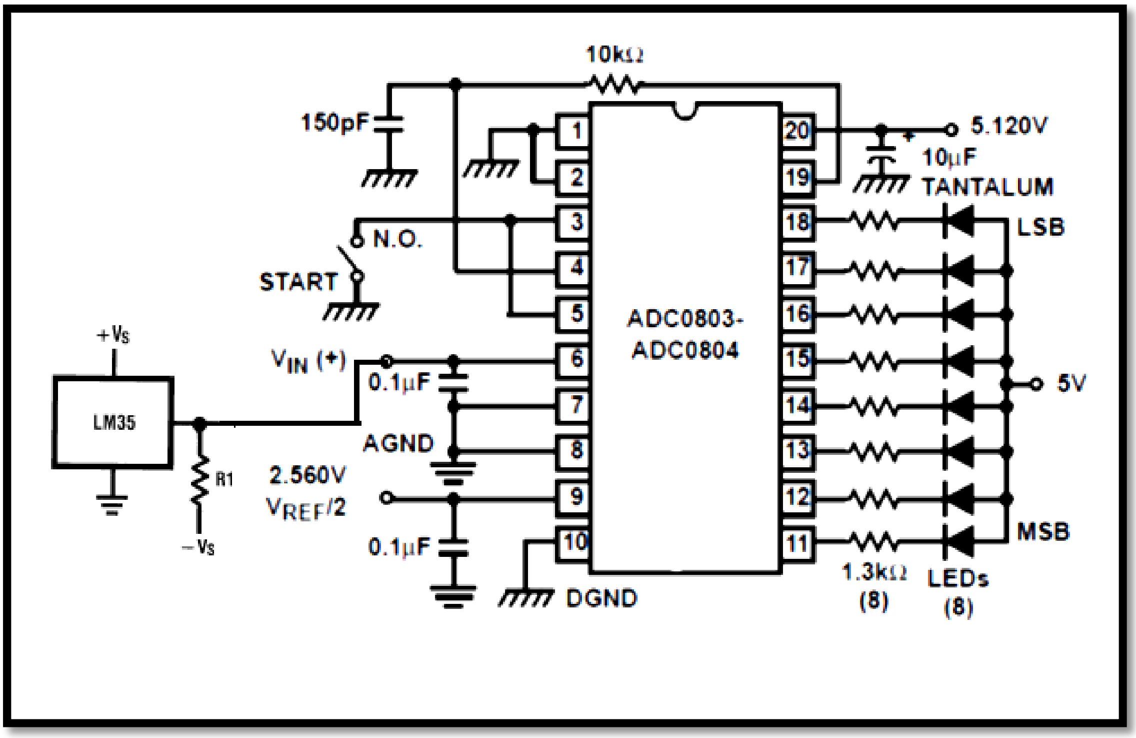


Figure 3.3: ADC CIRUCT DESIGN

3.4 Temperature Sensor

The sensor is The measurement of a physical phenomenon, such as the temperature of a room, the intensity of a light source, or the force applied to an object, begins with a sensor. A sensor, also called a transducer, converts a physical phenomenon into a measurable electrical signal. Depending on the type of sensor, its electrical output can be a voltage, current and resistance.

3.4.1 LM 35 Thermal sensor

The LM35 series are precision integrated-circuit temperaturesensors, whose output voltage is linearly proportional to theCelsius (Centigrade) temperature. The LM35 thus has anadvantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a largeconstant voltage from its output to obtain convenient Centigradescaling. The LM35 does not require any externalcalibration or trimming to provide typical accuracies of ±1⁄4°Cat room temperature and ±3⁄4°C over a full −55 to +150°Ctemperature range. Low cost is assured by trimming andcalibration at the wafer level. The LM35's low output impedance,linear output, and precise inherent calibration makeinterfacing to readout or control circuitry especially easy. Itcan be used with single power supplies, or with plus andminus supplies. As it draws only 60 μA from its supply, it hasvery low self-heating, less than 0.1°C in still air. The LM35 israted to operate over a −55° to +150°C temperature range,while the LM35C is rated for a −40° to +110°C range (−10°with improved accuracy). The LM35 series is available packagedin hermetic TO-46 transistor packages, while theLM35C, LM35CA, and LM35D are also available in theplastic TO-92 transistor package. The LM35D is also availablein an 8-lead surface mount small outline package and aplastic TO-220 package[10].The LM35 can be applied easily in the same way as otherintegrated-circuit temperature sensors. It can be glued or cemented to a surface and its temperature will be within about 0.01°C of the surface temperature. The figure (3.4) shows the pin configuration of LM 35.

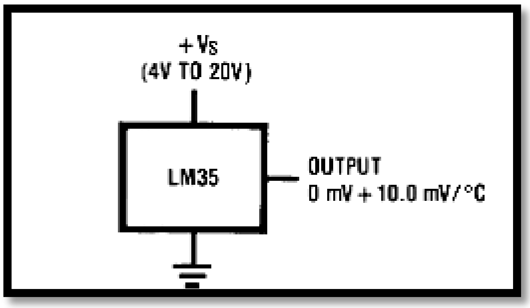


Figure (3.4). LM 35 temperature sensor

3.4.2 Thermal sensor types

3.4.2.1 RTD (Resistance Temperature Detector)

- Wire wound and thin film devices.
- Nearly linear over a wide range of temperatures
- Can be made small enough to have response times of a fraction of a second
- Require an electrical current to produce a voltage drop across the sensor

RTD Applications

- Air conditioning and refrigeration servicing
- Foodservice processing
- Medical research
- Textile production

3.4.2.2 Thermocouples

- Two wires of different metal alloys
- Converts thermal energy into electrical energy
- Requires a temperature difference between measuring junction and reference junction
- Easy to use and obtain

Thermocouple Application

- Plastic injection molding machinery
- Food processing equipment
- Deicing
- Semiconductor processing
- Heat treating
- Medical equipment
- Industrial heat treating
- Packaging equipment

3.4.2.3 Thermistor

- A semiconductor used as a temperature sensor.
- Mixture of metal oxides pressed into a bead, wafer or other shape.
- Beads can be very small, less than 1 mm in some cases.
- The resistance decreases as temperature increases, negative temperature coefficient (NTC) thermistor.

Thermistors Application

- Most are seen in medical equipment markets.
- Thermistors are also used are for engine coolant, oil, and air temperature measurement in the transportation industry

3.4.2.4 Infrared Sensors

- An infrared sensor intercepts a portion of the infrared energy radiated by an object
- Many types Optical Pyrometers, Radiation Pyrometers, Total Radiation Pyrometers, Automatic Infrared Thermometers, Ear Thermometers, Fiber optic Thermometers, Two-Color Pyrometers, Infra-Snakes, and many more.

InfraredApplication

- Manufacturing process like metals, glass, cement, ceramics, semiconductors, plastics, paper, textiles, coatings.
- Automation and feedback control
- Improve safety in fire-fighting, rescues and detection of criminal activities.
- Used to monitor and measure human body temperatures with one second time response.
- Reliability and maintenance needs from building heating to electrical power generation and distribution

3.4.2.5 Semiconductors

- Are small and result from the fact that semiconductor diodes have voltage-current characteristics that are temperature sensitive.
- Temperature measurement ranges that are small compared to thermocouples and RTDs, but can be quite accurate and inexpensive.

Semiconductor Applications

- Hard Disk Drives
- Personal Computers
- Electronic Test Equipment
- Office Equipment
- Domestic Appliances
- Process Control
- CellularPhonSemiconductorApplic

4.1 Introduction

The tracking of the satellite system need to know some information about the satellite statues such as location altitude solar cell ,earth sensor ,solar sensor ,and so on .So we need collect the reading of all sensors as telemetry data. These data are collected and transmitted to ground station to monitor the status of satellite.The ground station will sendtelecommand to correct the status of satellite.This process need a special protocol to do that.Our set up consist of the following parts.

4.2 sensor set up

The used of thermal sensor LM35 which the out put voltage is measured from pin 3, when it is supplied with 5v at pin 1,therefore the reading of Temperature and corresponding voltage is shown in table (4.1).

T(c)	**o/p voltage (mv)**
20	547
21	556
22	567
23	578
24	580
25	586
26	595
27	605
28	615
29	624
30	636

After that we connect the sensor with ADC 0804.The digital-output LED display can be decoded by dividing most significantbits (MS) and one with the 4 least-significant bits(LS). The output is then interpreted as a sum of fractions times the full scale voltage:

Vout=((MS ⁄16)+(LS ⁄256)

Value(MS,LS)	Voltage(mv)
00000001	0.02
00000011	0.06
00001110	0.28
11000000	3.84
00101001	0.82
11000111	3.98
11111111	5.1

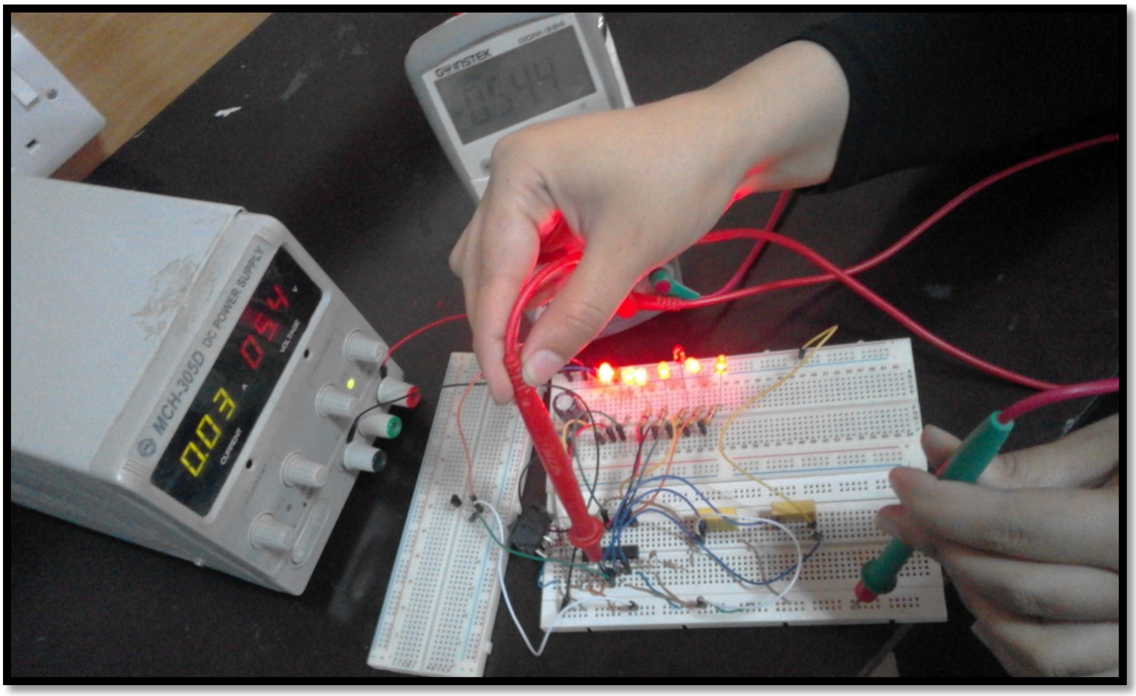
For example, for an output LED display of 1011 0110, the MS character is hex B (decimal 11) and the LS character is hex (and decimal) 6, so:

.

VOUT=((MS ⁄16)+(LS ⁄256))5.12

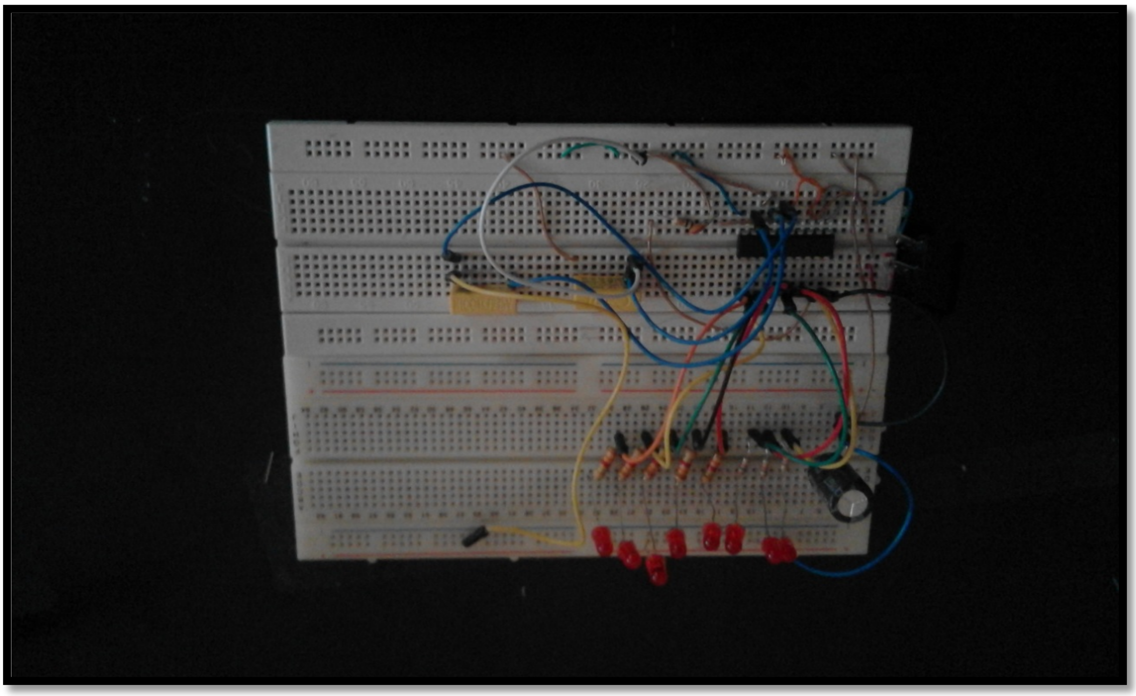
VOUT=((11 ⁄16)+(6 ⁄256))5.12=3.64V

The electronics circuits of the thermal sensor and ADC 0804 is shown in figure (4.1)



Figure(4.1). The electronics circuits of the thermal sensor and ADC 0804**1**

Figure 4.1 shows the ADC 0804



Figure(4.2)The circuit of ADC

5.1Conclusion

1. The system is stable,reliable and we can use it indifferent practical applications.

2.The resolution of the system is very good by using 8-bit ADC compatible with micro controller or Microprocessor.

3. We can use many different sensors by using multiplexing techniques.

5.2 Future work

1. The use of micro controller such as type Ardino will improve the performance of the system.

2.Use the type of sensors such as optical sensor,and pressure sensor.

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الخلاصة:

الهدف الرئيسي من هذا المشروع هو الزيادة في عدد الأقمار الصناعية لمراقبة الأرض والنهوض في أدوات وتقنيات المعالجة واستخدام البيانات في التطبيقات الجديدة الهائلة ومع ذلك تم توجيه الجزء الأكبر من جهود في الماضي نحو استخدام بيانات القياس عن بعد والان ايضا يتم استخدام البيانات في المايكروويف ثم محاكات تصميم وتنفيذ الحصول على البيانات الحرارية لنظام الاقمار الصناعية والقياس تجريبيا باستخدام نوع الاستشعارLM35 و ADC0804 كأن يستخدم 8 بت لتكوين احادي القطب0هذا النظام موثوق به ومنخفض التكلفة للحصول على البيانات بسرعة عالية0

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تصميم وتنفيذ الحصول على البيانات الحرارية لنظام الاقمار الصناعية

مشروع

مقدم الى قسم هندسة الأتصالات

في جامعة ديالى – كلية الهندسة كجزء من متطلبات نيل درجة البكلوريوس

في هندسة الأتصالات

من قبل

هالة نصرت

مروة قاسم

بأشراف

د.رياض خلف احمد

May/20161437/رجب