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Bite Controller for ESM Systems Controller for ESM Systems

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Abstract

Electronic Support measures (ESM) system is used to measure the parameters of radar emission in the operating frequency range along with pulse width, pulse repetition frequency, antenna scan period, signal strength, direction of arrival and more. These systems are installed in warships, aircrafts and submarines. The radar parameters along with their threat levels are to be made available to operator during the peace and wartime operations. In the modern ESM systems these parameters are to be measured instantaneously with great accuracies and instantaneously for tactical purposes. Different techniques are used for measuring different parameters of radar signals. Receiver measure these parameters in various parallel circuits and ensure the entire measured data is available less than 200ns for each pulse which is required for further processing. The BITE processor controls various operations of these parallel receivers. It controls the operation of system to ensure reliable performance. The BITE processor receives the signal from the ESM processor and generates it in the specified number of bits. It also interfaces ESM processors and antenna processors.

Index terms— electronic warfare (EW), electronic support measures (ESM), electronic intelligence (ENINT), antenna head unit (AHU.

1 I. Introduction

or the last few years one of the main things we have tried to emphasize are related to electronic warfare. The high effectiveness and widespread use of electronics, its associated equipment and weapon systems has led to the development of electronic warfare systems, to detect and counter these weapons. The stronger we are the safer and powerful we are. This is a why our country's EW capabilities have become the vital element which decides the outgrowth in the event of a campaign. The main enthusiasm behind this study is the need of high performance controller for the ESM systems.

Electronic warfare is to exploit the enemy's intention, plan and capabilities and to take a counter measure to deny the use of weapons systems and communication while safeguarding our own effective use of same spectrum. For this the EW uses ESM systems which measures the parameters from the radar emissions and detects the threats. The ESM system requires a high accurate, high speed and instantaneous controller to acquire updated information every moment. The BITE controller fulfils all the above mentioned Author ? ?: Department of ECE Sreyas IET Hyderabad India. email: pandu427@gmail.com abilities. Therefore, BITE controller is used all the ESM systems. Without such equipment the survivability of armed forces may be difficult.

II. Electronic Warfare (EW) Electronic Warfare (EW) is a military action which involves the use of entire electromagnetic spectrum or directed energy to prevent, exploit, reduce or determine the use of the spectrum as well as action and friendly use if electromagnetic spectrum as it is not conducted by using electronics whereas it use electromagnetic spectrum to detect the attack some people also called it as electromagnetic warfare.

In this modern world the complexity, performance and specialization of the weapons is directly proportional to the electronic. It is believed that in particular EW and in general electronics will play the dominated role in the battlefield. EW is not a new technology it was practiced in one or another form earlier in most of the

major conflicts. But it had gained its importance and maturity after world war -II. The main concept of EW to exploit the enemy's electromagnetic emission in all the parts of the spectrum to know the enemy's order of battle, capabilities and intention and to take the control measures to deny the use of communication and weapon systems. This spectrum is not limited to radar frequencies but includes ultraviolent, visible, IR and other less used portions of EW systems. This includes standoff, escort jamming, self-protection and anti-radiation attack. It is a specialized tool that enhances space functions and many air functions at multiple levels of conflicts. This is applied for air, land, space and sea by unmanned and manned systems.

EW is mainly subdivided into three major categories. Electronic attack (EA),Electronic protection (EP)Electronic warfare support (ES).Electronic attack (EA) This involves the use of anti-radiation weapons, directed energy, EM energy to attack facilities, personnel or equipment with the intent of destroying enemy combat capabilities. Jamming can be performed on communication system. Electronic protection (EP) is nothing but taking protection measures in the war field by counter measures. EP is also known as electronic counter measures (ECCM).The defensive EA action and EP both protects the facilities, and equipment.ES This is a sub division of EW which involves the actions tasked by or under direct control of an operational commands to identify, locate and intercept sources of unintentional and intentional radiated electromagnetic energy for the F Global Journal of Researches in Engineering ( ) Volume XVI Issue III Version I purpose of targeting, planning, immediate threat recognition and conduct future operations.

2 III. Electronic Support Measures (ESM)

ESM is a division in EW which involves the action that are taken under the direct control of an operational commander which helps us to detect, record and analyse sources of electromagnetic energy which are been radiated. By recognizing this radiation the immediate threat can be avoided by taking the control measures. ESM will collect the intelligence through the passive listening to electromagnetic radiations of military interest. These systems will provide us very valuable information about the foreign system. It provides the operational data, tactical combat information about the foreign systems. ESM can be well described as a platform on electronically silent and analyses the radar transmission beyond the RADAR detection range as it has a greater power of electromagnetic pulse which is been transmitted with respect a reflected echo of that pulse.

This has a desirable characters like wide dynamic range, narrow bandpass, good angle-of arrival measurements which will be used to locate the transmitter, and another main important character is it has a wide spectrum This ESM has two basic types they are Electronic intelligence (ELINT), Communication intelligence (COMINT).

The ELINT will analyse the radar emission, missile guidance radars in order to provide the protection COMINT-From the name communication we can define COMINT as an intelligence which is intended for the interception of communication .These both intelligence systems are highly dependent on digital computers to provide the analysis function. Before any operational mission this functions are carried out on a software program which will give the necessary analysis on multiple signals. The processor will contain parameter of 2,000 or more radar system. In many cases if the program is not available then it can be reprogrammed by the operator to store the unidentified signals for later processing and analysis.

The processing of the signal consists of three stages in sequence 1 st stage sorting of the radar pulses as they come in.2 nd stage segregation of the pulse trains.3 rd stage identification of the emitter .ELINT and COMINT works together known as signal intelligence (SIGINT).

3 IV. Electronic Intelligence (ELINT)

Electronic intelligence it is essentially procured from the electronic signals which doesn't carry speech or text .It is sub divided into categories. Technical ELINT in this sector it traces about the Modes of the operation Emitter functions Weapons systems Emission characteristics Navigating signals .The chief motto of this sector is to secure signals specification and reports the task, potentials and functionality of the emitter which performs in the huge system. As of ground radar locating aircraft and thus become the prototype of radar recognition, counter weapons apparatus. The comprehension of this incorporate operation of counter measures which also a part of the electronic warfare.

Another major sector is operational ELINT another vital sector operational ELINT which focus on to detect precise ELINT goals and regulate the operational designs of the sector. These outcomes are frequently called Electronic order of battle. The ELINT also contribute caution evaluation, usually mentioned as skilful ELINT. The ELINT intelligence outcomes support military operational planners and tactical military commanders on the battle field.

A former third major branch of ELINT is the group, processing, and outline of foreign telemetry signals intelligence. TELINT is technical intelligence information obtained from the intercept and analysis of foreign telemetry. Once Telemetry Intelligence was accounted as a branch of ELINT since TELINT now to be called Foreign Instrumentation Signals Intelligence (FISINT) these are closely related to Tech ELINT procedures which were held by all of the Department of Defence military departments. TELINT is a critical source of performance information on foreign missiles and space vehicles while they are being developed and tested. TELINT can also provide much operational information on foreign satellites and space vehicles.

ELINT is not only used for direction finding but also for the report of the incoming signals for taking the actions immediately in the missile systems, fire controls and radars. After receiving the signal it gives the warning to the systems and the processors which are connected to it will respond immediately for proving the parameters such as frequency, direction and pulse. With these parameters it is easy enough to find out what type of emitter it is and rest of the completions with the parameters and the signal analysed for air crafts and ships warning systems are the most important because for the survival in the environment of the battle field .

4 V. Antenna Head Unit (AHU)

The antenna head unit is the main part of the ESM systems because the signals are transmitted through it. The AHU processor it receives various control signals from the receiver processor. These control signals are also called as control codes. These control codes are decoded and are sent to the next stage in the ESM system. The control codes are also given to the BITE (built -in-test-equipment) controller which will generate the frequency. Now auto calibration should be done so for the execution of the auto calibration by the AHU processor we require interface circuits. These The AHU processor will supply all the control signals so as to provide an interface for the purpose of the auto calibration in the system. The AHU processor will send control signals to various parts. So, to send the signals to various parts it should be designed in such a way that it will send at a speed of 1.2micro seconds. It will acts as an interface between the RF signals processor and the ESM processor, in receiver processor RF signal is compared with many other signals and then after the comparison then a command code is entered in to the AHU processor. The AHU will decode the given command code and it provides us the frequency, attenuation and various other parameters.

The AHU has 2 modes of operation. They are, BITE mode & Normal mode. The signals will be changed by the AHU processor to have the system in the normal mode or the bite mode. AHU uses 5 BITS of amplitude which is given by the threshold level.AHU will be having two inputs Serial communication which is given by the receiver processor .Blanking signal from RADAR to keep the system in the BITE mode. In the bite mode signals are sent by the line driver for the purpose of elimination of the noise in the system.It does not detect its own signal in the BITE mode .AHU will convert the RF signal in to the video signal .which can also be used to measure the radar parameters Finally , if AHU fails the entire ESM system fails as it is the most important part . Whenever the ESM system receives the RF signal, it first sends it to the front end receiver where the signal is amplified. This receiver also suppresses the noise in the received signal. The signal is then given to the ESM processor. The ESM processor sends an 8 bit serial communication data to the BITE processor using NMEA0184 or NMEA0185 protocol.

The BITE processor usually has a database. The received signal is compared with all its signal parameters in the database. When all the parameters are matched, the receiver gives the required outputs in a specified number of bits i.e., amplitude of 5 bits, frequency of 12 bits, type of the signal continuous wave (CW) or pulse of 1 bit, 3 serial link lines and the mode of the system. These outputs are given to the line drivers for the removal of noise before sending it to the interfaced circuits. The ESM system generally has 2 modes, Normal mode and BITE mode. When the system receives signal from the external environment radar signals it operates in normal mode When the system takes the information from the internal sources . the BITE processor operates in BITE mode. The entire significance of ESM system lies in this mode of operation which is due to the signals given by the ESM processor. When the system is in BITE mode it enters into idle state and the entire data base of the BITE controller is thoroughly compared and the accurate output is given.

The BITE processor checks and indicates if the generated signal is in continuous wave or pulse mode.

The BITE processor also sends a serial link data to the Antenna Head Unit (AHU). This data has 2 functions, to send the commands to the AHU to keep AHU hardware in BITE/Normal mode according to the mode of the BITE processor and to receive the response from the AHU processor. The entire operation described above will be performed in less than 200 nanoseconds. The output bits of BITE processor are sent to the next stages of the system for further operations. In this paper the need of modern electronic warfare has been presented. The most usually used ESM system and its sub-parts have been discussed. The BITE processor and its working have also been presented. The major guidelines for further study and development lies in the advancement of the circuitry to endure extreme conditions and optimization of the circuit for the best use of the system for tactical purpose.

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Figure 1: F

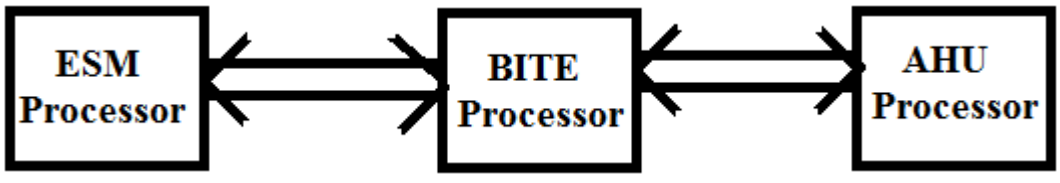

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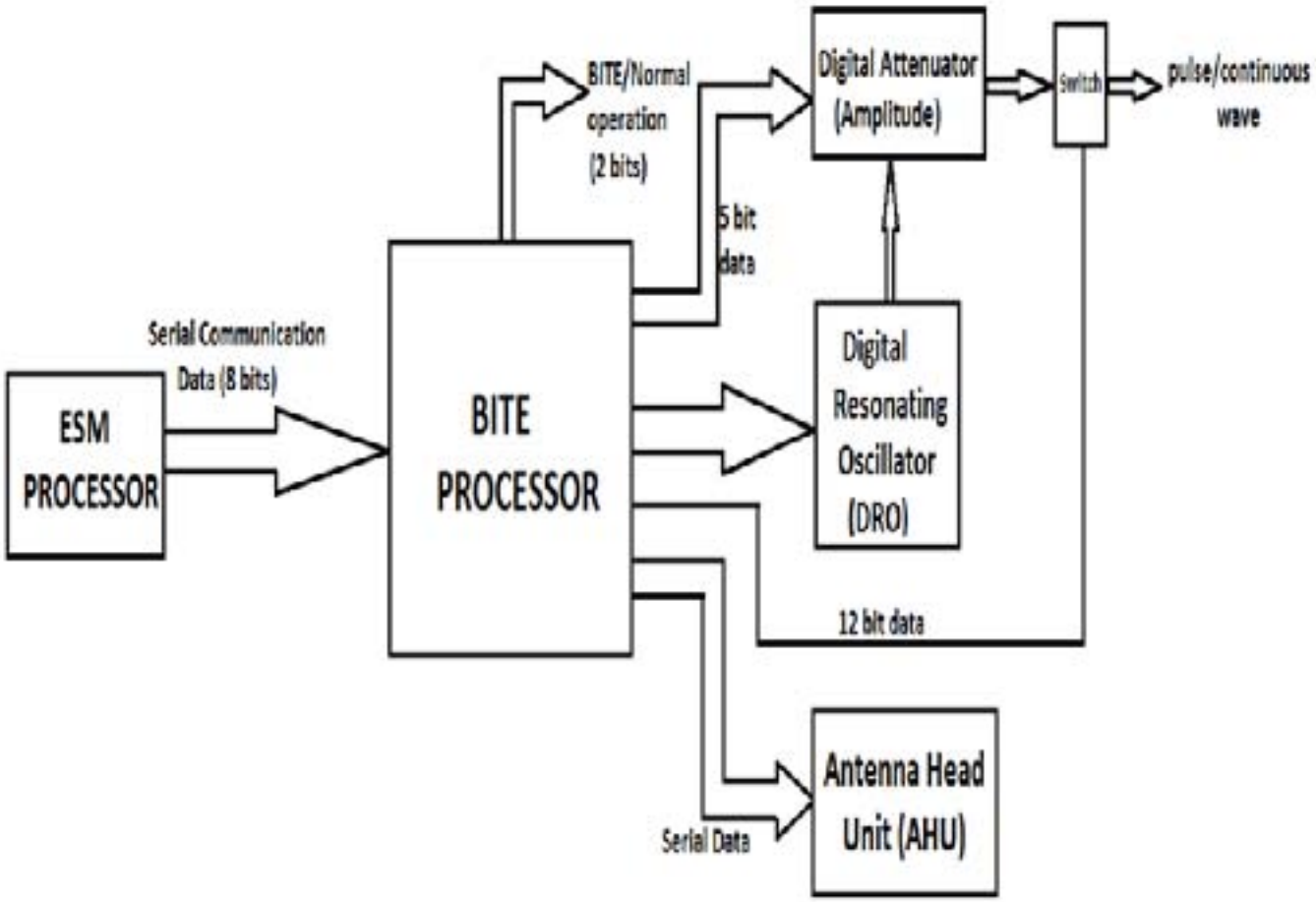
Figure 2: Fig 1 :Fig 2 :



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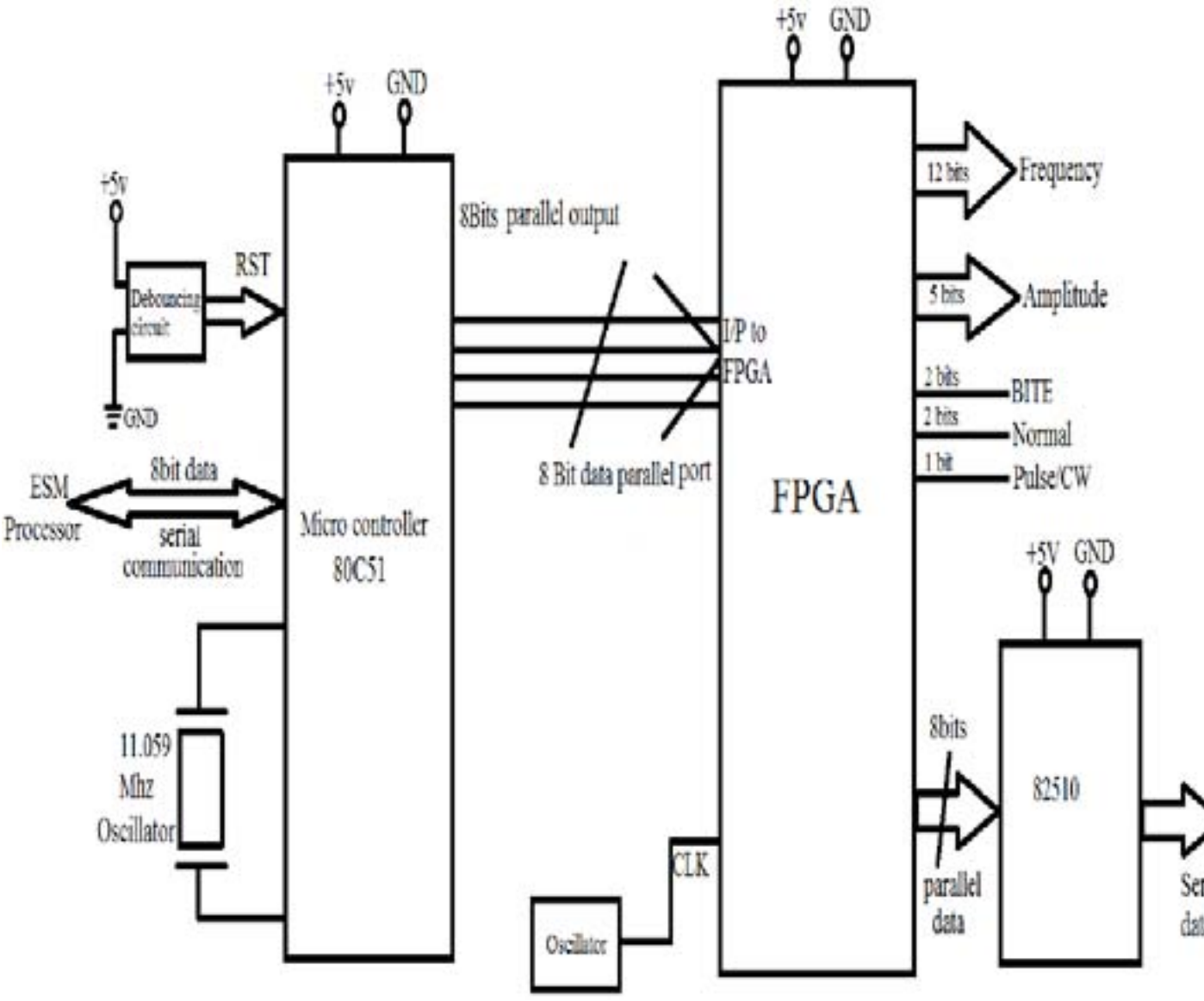
+5v
GND
+5v
GND
+5v
GND
12 bits
Frequency
5 bits
Amplitude
2 bits
BITE
2 bits
Normal
1 bit
Pulse/CW
+5v
Debouncing circuit
RST
GND
8Bits parallel output
I/P to FPGA
8 Bit data parallel port
FPGA
ESM Processor
8bit data
serial communication
Micro controller 80C51
11.059 Mhz Oscillator
CLK
Oscillator
+5V
GND
8bits
parallel data
82510

Figure 4:

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