DESIGNING AND DEVELOPING OF GLOBAL POSITIONING SYSTEM BASED DEVICE USED FOR TIME SYNCHRONIZATION

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ABSTRACT: *Time synchronization in power and process industry with higher accuracy is the main motive of the device. This device is cost effective time synchronization solution. The reference time of this device is GPS signals which is received by the GPS receiver and timing information from the signal is being used and different format of timing output signals are generated. Device will generate three different format of signal 1PPS signal, Ethernet signal and IrigB signal. In IrigB signal device will generate DC-level shift signal and amplitude modulated signal This signals are provided to the devices which need to be synchronized by accurate time. For generating different output signal formats the main component is pic microcontroller and for Ethernet output signals the NTP protocol is used. In which the device will be server. And the device which require the timing signals will be the client. Basically the device will have to first find the timing information from the signal received by the GPS receiver it will have many different kind of information from that all information only timing information will be considered and than it will be converted in different format of signals as described. So GPS receiver is also the main component of the device which will provide the reference signal to the device .when GPS receiver will be able to receive the signals from satellite than GPS is locked else GPS is unlocked so by the status of LED we can know GPS is locked or unlocked. In unlocked condition receiver will still send the 1pps signal to the device.*

Keywords- GPS-Global positioning system, NTP- network time protocol, IRIG- Inter-range instrumentation group , Modulated , TTL-transistor transistor logic,

I: INTRODUCTION

Our device has been developed to address key power and process industry timing requirements Whether it’s the monitor, control or analysis of the power system, the Device is the cost-effective GPS time synchronization solution. To begin with, the offers superb timing accuracy Using GPS satellites, it generates extremely accurate output pulses and time codes in multiple formats. The Device synchronizes a wide variety of microprocessor-based power system equipment including: SCADA systems, remote terminal units (RTUs), protection relays, sequence of event recorders, digital fault recorders, tariff meters, Slave Display Units, Data Loggers and other Intelligent Electronic Devices (IEDs).Each output can feed directly to different areas through electrically isolated ports which ensure reliable operation in a harsh substation environment. The Device generates a wide range of timing signals. The Device is available with one 1PPS Port, two Ethernet port and two IRIGB (AM/PWM) outputs. Optional outputs include one IRIG-B AM/PWM, 1PPS and one Ethernet output (NTP).All Din Rail GPS units feature a front panel LED indicators provide “at a glance” status information. The optimized Receiver/Antenna system employed in the Device provides time information from the GPS satellite

Maximum Distance: 10 meters

Isolation: 2000 M_ at 500 VDC.

IRIGB-TTL (PWM)

TTL Output (Impedance: 50 Ohm),Rise<=Time: 15ns,Front Panel BNC Female

Maximum Distance: 10 meters,Isolation: 2000 M_ at

2 = Modified Manchester modulated

IRIGB-Amplitude Modulated
1 KHz AM Signal,3:1 Modulation Ratio,0-10Vpp (Unloaded),0-3 Vpp (50 _ load)
Front Panel BNC Female,150 _ Output Impedance,Isolation: 2000 M_ at 500 VDC.

Ethernet Output:
Time Synchronization protocols: NTP/SNTP
Server [Factory settable]
NTP : Network Time Protocol,: RFC- 1059, RFC- 1119, RFC- 1305
SNTP : RFC- 1361,Network Protocol: OSI Layer4
Transport layer: TCP, UDP,Internet protocol : IPv4
Modes : Server / Broadcast,Protocol Time format: UTC
Protocol standard : Universal,Network Interface: 10 Mbps, RJ- 45
Isolation: 2000 M_ at 500 VDC

Status LED
Power : Red
PPS : Red
GPS Locked : Red

Configuration
Telnet protocol (PC- Ethernet Port of GPS)
a. Global Time zone correction
b. Password Protection
c. IP address, Subnet mask, Gateway

Power Supply
Aux Supply : 18-76V DC, 90-270V AC
Consumption : 5 Watt (with full load)

II: APPLICATION OF DEVICE

The **Device** can be used wherever there is a requirement to accurately synchronize equipment.
Typical applications include:
a. Digital Fault Recorders (DFR)
b. Sequence of Event Recorders (SER)
c. Supervisory Control and Data Acquisition Systems (SCADA)
d. Power Line Fault Detection using Time Domain Reflectometer.

III: OUTPUTS

Pulse: 1 PPS
Accuracy <100 ns with GPS locked,TTL Output (Impedance: 50 Ohm),Rise Time: < 15 ns
200 ms Pulse Width,Front Panel BNC Female,

B x y z
[Format] [Modulation type] [Frequency/resolution] [Coded expression]
"B" denotes IRIG-B
"x" designator, modulation type has three possible values:
0 = Unmodulated, also called DC level shift
1 = Amplitude Modulated (AM) sine wave

The "y" designator, frequency/resolution has values as follows:
0 = no carrier / index count interval (commonly used with IRIG-B)
1 = 100Hz carrier (not used with IRIG-B)
2 = 1000Hz carrier (commonly used with IRIG-B)
The "z" designator, coded expression has values as follows:
0 = BCD, CF, SBS
1 = BCD, CF
2 = BCD
3 = BCD, SBS
BCD = Binary Coded Decimal format = basic time-of-year information (does not include year information).
CF = Control Function = additional information including year information. (Not used in this unit).
SBS = Straight Binary Seconds = seconds-of-day in binary format.
The valid combinations in use for IRIG-B are: B00z, B12z and B22z.

B00z (DC level-shift IRIG-B)
B00z (DC level-shift IRIG-B) has been favored for use with new equipment in substations because, although it cannot be used for wiring runs of more than about 100 meters, it offers good timing accuracy.

As long as the GPS clocks outputs are isolated and therefore balanced this effectively eliminates problems due to induced noise that can cause difficulties using this form of time code in sub-stations.
This code can also be easily transmitted over fiber. Demodulation is not required, so the code can be very simply received and used by connected equipment B12z (Amplitude Modulated IRIG-B)

B12z (Amplitude Modulated IRIG-B) has historically been widely used. Because this modulation is a 1Khz sine-wave, timing accuracy is inherently limited by the wave shape. This is, therefore, the least precise of all of the IRIG-B varieties, but has been in common use because, with no DC content in the signal, it lends itself to transmission over long distances. The sine-wave zero-crossing transitions have to be placed very precisely by the GPS clock (within a few microseconds of absolute UTC time), so that very good precision can still be obtained provided that the receiving equipment employs a reasonably sophisticated demodulator (e.g. PLL) to recover the timing accuracy. Sub-millisecond accuracy is achievable.

NTP / SNTP Time Protocol :

NTP(Network time protocol) is a common method for synchronization of hardware clocks in local and global networks. The software package NTP is an implementation of the actual version 3 [Mills90], based
port and two IRIGB (AM/PWM) outputs. Optional outputs include one IRIG-B AM/PWM, 1PPS and one Ethernet output (NTP). Device feature a front panel LED indicators provide "at a glance" status information

III: TIME SIGNAL OUTPUTS

This is a very important timing signal. It is the TTL level pulse with a width of 200ms isolated output coming from the GPS receiver. This 1pps is connected to the BNC connector on the front panel.

IRIG-B AM/PWM

The IRIG-B format is a serial format based on a message frame per second which is Co-ordinate with the synchronized 1pps time output pulse. There are two alternative forms of output, PWM output and a modulated output. The modulation frequency is 1 KHz.For IRIG-B, each one of these codes is 10 ms long, which is 10 cycles for the modulated format. There are 100 possible codes per time frame, although not all of them are used. The day number starts at 1 on the first of January.
There are a number of variations of IRIG-B time codes in common use. IRIG-B time codes are defined using a 4-character descriptor: "B x y z", and "x", "y" and "z" have meaning as follows:
on the specification RFC-1305 from1990 (directory doc/NOTES).

Other NTP compatible Versions are NTPv1 (RFC-1059), NTPv2 (RFC-1119), RFC-958.
GPS is being provided with Internal protocol based Universal time synchronization protocol i.e. SNTP (Simple Network Time Protocol) / NTP (Network Time Protocol) used to synchronize the various clocks of NTP clients to adjust with universal time.

SNTP uses the standard NTP timestamp format described in RFC-1305. Network Time Protocol is widely used to synchronize the time for Internet hosts, routers and ancillary devices to Coordinated Universal Time (UTC) as disseminated by national standards laboratories.

GPS time protocol is transmitted via RJ-45 connector on UDP layer (RFC-768) at 10Mbps.GPS transmits NTP packets in various optional modes i.e. Server / Server Broadcast depending on the applications of client module. NTP packets involve the timestamp value according to UTC (Universal Time) time.
Server mode:GPS responses with current timestamp when the query is received from client. Broadcast mode: GPS broadcasts the NTP packet at fixed intervals to clients.

IV: DEVICE DESCRIPTION

we make use of those devices and make the hardware and software to get the appropriate accuracy of timing signals so in papers only information about the NTP,PTP and GPS receiver is given but by using all those devices and other electronic components how to make the Hardware and how to program the controller so that we can get timing signals from the Device How to implement code by which the signal coming from GPS receiver will be converted in other

format
and how to take only timing information from the gps receiver's signal and make different format of signals like irigB signals than NTP output signals in IRIGB signals there will be two types one will be analog signals and one will be digital signals.

So according to customer requirements we make different kind of output signals for that we make both hardware and software to get higher accurate timing output signals which is our main aim to get after completion of the dissertation for more accuracy we are planning to work on the PTP(Precise Time Protocols) which gives accuracy in nano seconds after completion of the NTP(network time protocol) which will give the time accuracy in the milliseconds.

So our main aim is to get the highly accurate timing signals which synchronizes the different devices in power industry and in other industries also.
we will combine all different components in which there will be GPS receiver, pic microcontroller and NTP will be the main devices to provide appropriate timing Signal required Accuracy to the customers.
Device generates a wide range of timing signals. The Device is available with one 1PPS Port, two Ethernet.

V: PARTIAL WORK EXECUTED

For getting the accurate timing signals we have prepared hardware till now and now the programming is going on.in the hardware tha main components are pic microcontroller,GPSM12Mreceiver, EPROM,watchdog IC.

These are the main components we have used So here we have selected particular components for specific reasons. We have used 16-bit pic microcontroller named as pic18f97j60 because it is low cost compare to other controllers and it is having on chip physical layer which is very useful in having Ethernet output otherwise we need to take another device who save physical address of layer.

All members of the PIC18F97J60 family of devices feature an embedded Ethernet controller module. This is a complete connectivity solution, including full implementations of both Media Access Control (MAC) and Physical Layer transceiver (PHY) modules. Two pulse transformers and a few passive components are all that are required to connect the microcontroller directly to an Ethernet network. PIC18F97J60 provide a dedicated 4-pin signal interface for the Ethernet module.
No other microcontroller or peripheral functions are multiplexed with these pins, so potential device configuration conflicts do not need to be considered. The pins are:

- TPIN+: Differential plus twisted-pair input
- TPIN-: Differential minus twisted-pair input
- TPOUT+: Differential plus twisted-pair output
- TPOUT-: Differential minus twisted-pair output

Provisions are not made for providing or receiving digital Ethernet data from an external Ethernet controller or MAC/PHY subsystem.

For getting accurate timing signals we have implemented the hardware which provides the NTP and IRIGB output signals.this signals are transmitted to different devices which needs to be synchronized with time. So here are the schematic of the device.

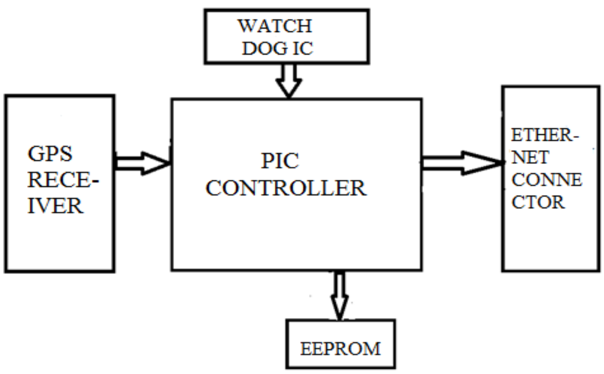

Figure-1 NTP output blockdiagram

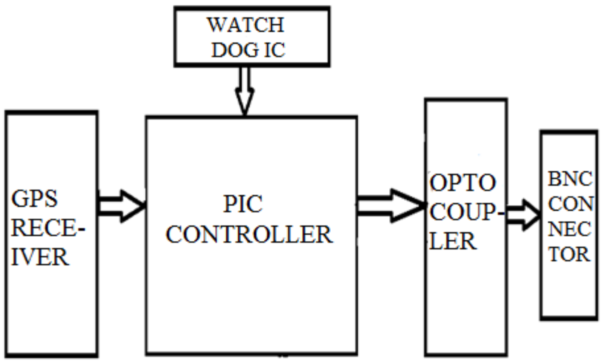

Figure-2 IRIGB TTL output block diagram

VI: CONCLUSION

The device is designed to provide the highly accurate timing signals in different format which can be mainly useful in power industries and in other areas also. Now a days use of computer and internet is common in any field so the device provide Ethernet output and from Ethernet the timing signal is known as NTP timing signal.and the reference time is taken from highly accurate timing signal provider GPS receiver. constellation. Dynamic T-RAIM processing is used to eliminate any aberrant satellite signals from the timing solution. The result is timing precision on all outputs with accuracy similar to that normally seen only in laboratory instruments.

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