APPLICATION OF CURRENT TECHNOLOGY TO LORAN-C RECEIVER/PROCESSOR

ILA 29th Annual Convention & Technical Symposium, Nov 14,2000

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The technology made available in the recent past, has made possible advancements in Loran receiver design, that were not possible. The increase in processing speed of microprocessors coupled with the increase in analog to digital conversion (ADC), speeds and range, initiated the development of a "different" Loran receiver, developed by LORMEGA.

Over the years there have appeared many receivers developed using microprocessor technology, but few coupled with the recent advancements in the area of ADCs. This paper is intended to present this development, and the benefits of it.

Microprocessor Advancements

From the mid-70s using 3 Intel 8008 processors, to 1 8080 Intel processor, to an Intel 8086 processor, to the current use with a PC type processor, the ever increasing capability to process sampled data, has been one of two critical paths leading to the current LORMEGA design. This particular development chose to use a standard PC as a development tool. An ISA prototyping board, Figure 1, was populated with 3 programmable gate arrays, a 25 MHz conversion rate ADC, 10 MHz clock, data processing RAMs, and assorted logic of adders, interfaces, etc. With current technology this assortment of components can be reduced to 3 inexpensive chip assemblies. The software was developed using turbo-Pascal language, and the three gate arrays are easily changed via a PC resident software algorithm.

ADC Advancements

As mentioned, a 25 MHz rate ADC was "piggy-backed" to the prototyping board, and interfaced with the LORMEGA developed data reduction technique, which allows for a single ADC to provide data for multiple Loran chains or dual orthogonal loop antennas, as shown in Figure 2. The conversion rates and ranges available today, have provided the essential ingredient in the development of LORMEGA's 100% digital processing receiver. The methods implemented in the past, such as servo tracking, envelope delay and add techniques, time

constants, etc. have all been replaced with data reduction techniques, which all but eliminate many of the time delays experienced in the past. The acquisition and settle times using the current brassboard have been reduced to less than 1 minute under all signal conditions. The clock speed used in the LORMEGA brassboard was 10 MHz. The instrumental accuracy is < 100 ns, made possible by the analog range and resolution of the ADC.

System Advancements

The combination of the two elements above with high density RAMs, high-speed digital adders, etc. have produced significant improvement in the acquisition and settle times as well as accuracy. The format of the available data, allowed for incorporation of features like synchronous interference rejection via selective sampling, digital filter techniques, and others. The size of the RAM, 8K, used in the digital processing section of the LORMEGA brassboard was chosen to satisfy the tracking requirements. The acquisition algorithm was purposely configured to "fit" within the capability of this RAM size. With the reduced cost of RAMs, a choice today would be to use a larger capacity RAM, which would reduce acquisition time to less than 3 seconds, and a settle time of less than 20 seconds, bringing the total time to less than 30 seconds max.

It is performance like this, which the writer feels, gives Loran the competitive edge in the FAA requirement being imposed upon cell phone manufacturers to provide position location for 911 call initiators. From initial conversations this writer had with cell phone manufacturers, the addition of a whip antenna to a cell phone is a limiting practical factor. My question to this audience is this a challenge or is it feasible? In the event of a true life or death emergency such as a 911 call, would a user really object to a telescoping antenna, which is activated by the 911 call only? The market for this application is rather large. Can anyone suggest any other system that would be able to provide accurate relative position information to a local cell phone center, which could easily already have it's position tracked with Loran? The time to obtain position data from a cold start is a key in this application. A cell phone could in many cases, if not the majority, be turned off, in a pocket, briefcase, handbag, etc. I don't know of any other system, from a cold start, that can provide the accurate relative position data to a cell phone base in 30 seconds or less.

SUMMARY

It is felt that the best way to present the benefits described in the previous words, is to see it. Seeing is believing, and this is possible. It is the writer's feeling that the best way to exhibit this equipment is using a simulator to exhibit all the features, and also a live, "on the air" demonstration. Anyone interested in contacting the writer for additional info on setting up a demonstration please contact "lormega@home.com".

Figure #1 - LORMEGA Brassboard

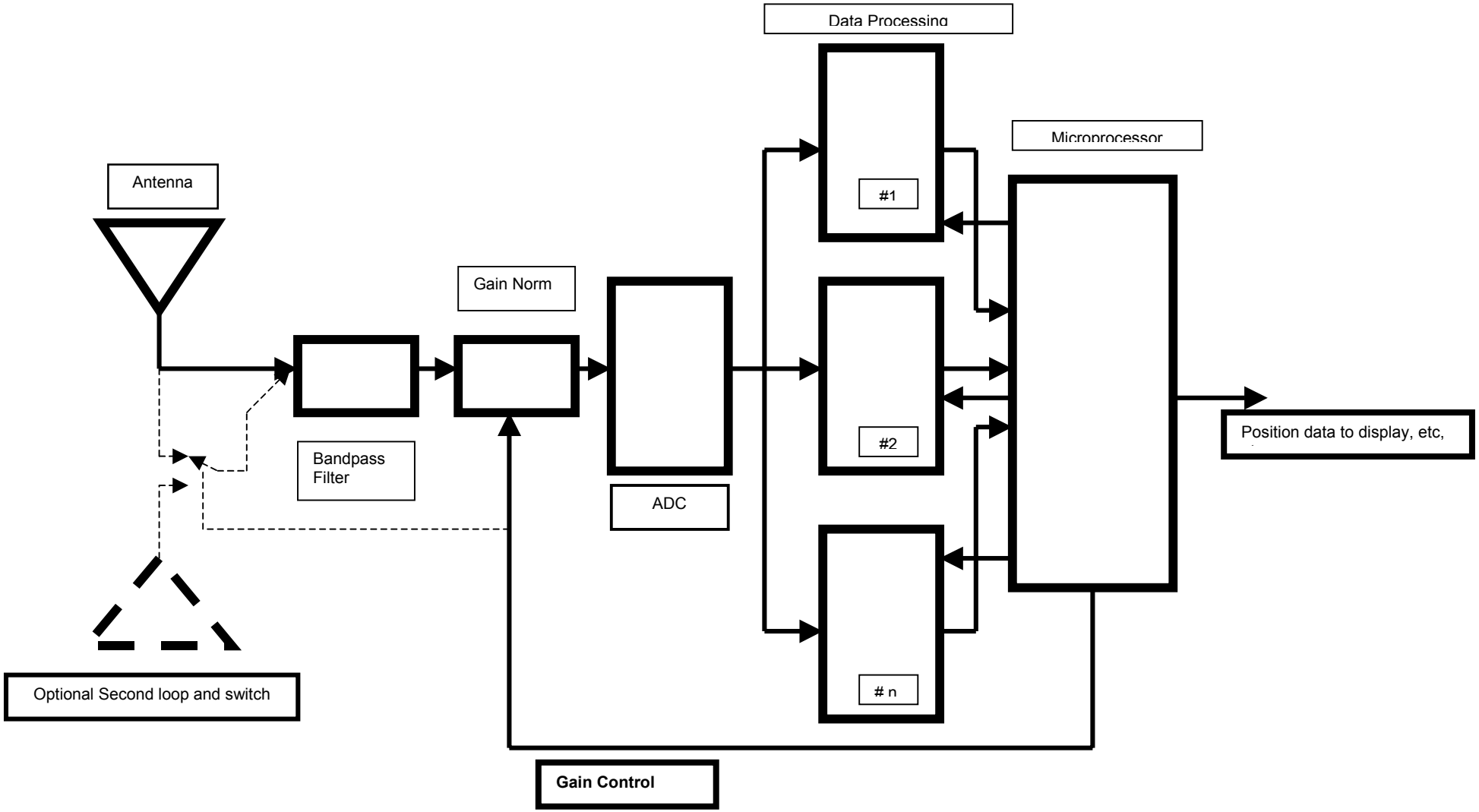

Figure #2 - LORMEGA RECEIVER BLOCK DIAGRAM