

Zero Crossing (us)	Time (us)	Tolerance (ns)	
		Category 1	Category 2
5	-25	+1000	+2000
10	-20	+100	+1500
15	-15	+75	+1000
20	-10	+50	+500
25	-5	+50	+250
30	Standard zero crossing	(Time Reference)	
35	5	+50	+100
40	10	+50	+100
45	15	+50	+100
50	20	+50	+100
55	25	+50	+100
60	30	+50	+100

Beyond 60 us the zero crossings conform to 100kHz + 1kHz

**TABLE 2 – ZERO-CROSSING TIMES (WITH RESPECT TO THE STANDARD ZERO CROSSING) AND TOLERANCES.**

## B. Pulse Groups

### 1. Group Repetition Interval (GRI)

Each Loran-C station operates with a specified GRI. As published in the Federal Register Volume 40, Number 29 of 11 February 1975, permissible GRIs are multiples of 10 microseconds from 40000 through 99990 microseconds. The identifier of the GRI is the GRI code, which is defined as the GRI in microseconds divided by 10 (i.e., 7980 to define a GRI of 79,800 microseconds).

### 2. Timing of Master Pulse Group

The 1987 amendment to Public law 100-223, 1982 Airport and Airway Improvement Act, requires that all master Loran-C transmitting stations subject to U.S. jurisdiction be synchronized to within approximately  $\pm 100$  nsec of Coordinated Universal Time (UTC). Since 1989, the U.S. Coast Guard has been working in conjunction with the US Naval Observatory (USNO) to achieve this somewhat ambiguous goal. At the time of printing, the standard zero crossing of the first master pulse of Group A is normally synchronized to within 500 nsec of the UTC second. By improving administrative control methods, master station offsets of  $\pm 200$  nsec can be

achieved. Various other methods are being studied in order to fulfill the requirements of public law. Because the GRI's of chains differ, it is necessary to relate the timing of all master stations to a common epoch. This epoch is 0 hr, 0 min, 0 sec, 1 January 1958. The expected Times-of-Coincidence (TOC) of a master station's transmissions with the UTC second are published in the Times of Coincidence, Null Ephemeris Tables, Series 9 developed by and available from USNO. The difference between the time of the master's transmission with respect to UTC is also published by USNO in the Series 4 and Series 100 Bulletins. USNO Time Service Information letter of 15 August 1973, provides guidelines for making time measurements.

### 3. Timing of Secondary Pulse Groups

Secondary pulse groups are transmitted with the same GRI as the master pulse group and are linked in time to the master. The emission delays of secondary stations with respect to the master are selected to ensure that the following criteria are met within each chain wherever the signals can be received:

- a. The minimum time difference between any secondary and master is 10,900 microseconds.
- b. The minimum difference of any two time differences is 9,900 microseconds.
- c. The maximum time difference is the Group Repetition Interval minus 9,900 microseconds.
- d. The minimum spacing between corresponding points of the last pulse of any station's group and the first pulse of the next group in the same chain is 2900 microseconds, except that the minimum spacing between the master's ninth pulse and the next secondary pulse (of the same chain) may be as little as 1900 microseconds. (This is a direct result of applying the first three criteria.)

Figure 3 is provided as an aid to understanding these criteria. In general, emission delays are kept as small as possible to allow the use of the smallest GRI.

Tolerances on the synchronization of secondary station transmissions with respect to master transmissions may vary from chain to chain. See Chapter 3.B for chain control procedures and Chapter 3.C for Loran-C chain details.

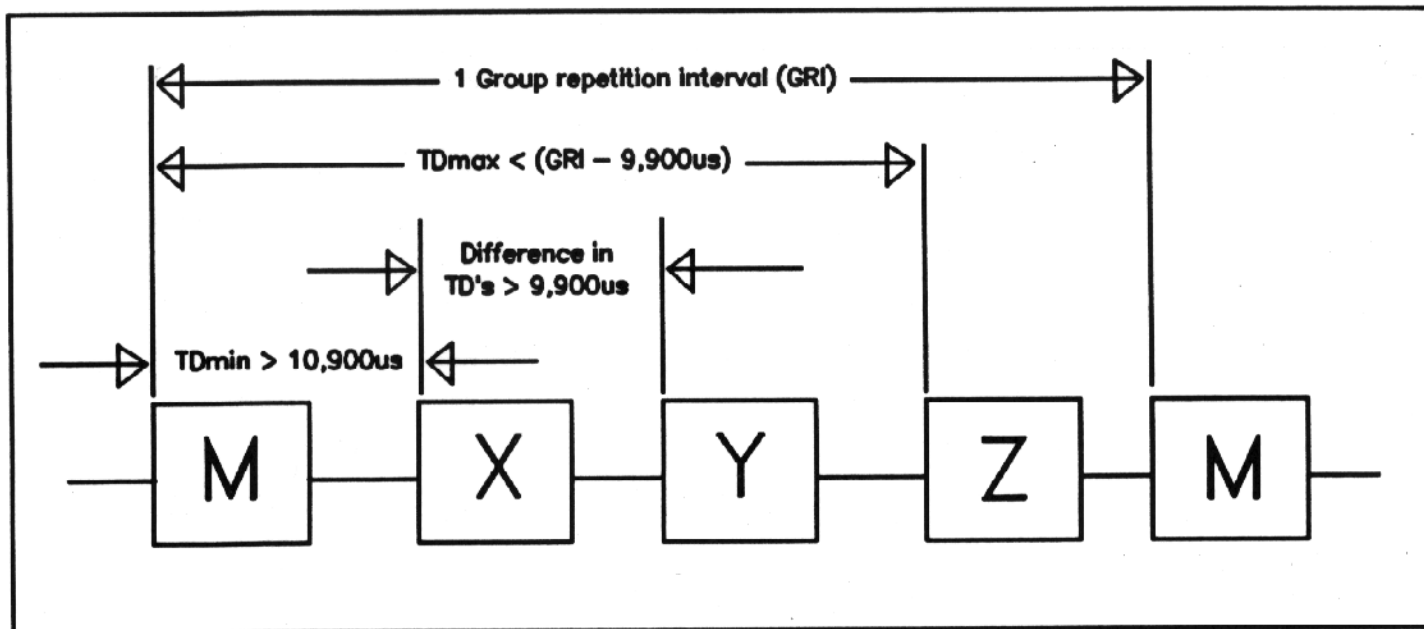


Figure 3 - Constraints for assignment of emission delay

4. Pulse-Group Phase Coding

Each Loran-C station transmits groups of phase-coded pulses in conformance with Table 3. For identification, the first group of pulses in the transmission sequence is labeled Group A and the second group, one GRI later, is labeled Group B. A transmission sequence (called phase-code interval (PCI) encompasses both Group A and Group B; thereafter, the sequence repeats.

<u>Group</u>	<u>Station</u>	
	<u>Master</u>	<u>Secondary</u>
A	++--+-+--+	+++++--+
B	+---+++++	+--++---

TABLE 3 - LORAN-C PHASE CODES

5. Uniformity of Pulses within Pulse Group

The uniformity of pulses within a pulse group depends not only on what equipment is in use, but also on whether or not the station is single-rated (SR) or dual-rated (DR).