



SYSTEMS MANAGEMENT STANDARD

SAE9990™

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Transmitted Enhanced Loran (eLoran) Signal Standard

RATIONALE

There is a need for an independent, complementary, multi-domain positioning, navigation, and timing (PNT) system that may interoperate with the Global Positioning System (GPS), other Global Navigation Satellite Systems (GNSS), or PNT sources.

FOREWORD

Long-Range Navigation (LORAN) is an internationally-recognized PNT system used by many modes of transport and in other applications. eLoran is the latest in the longstanding and proven series of low-frequency systems that takes full advantage of state-of-the-art hardware and software technologies that provide a data channel and time of transmission capability not implemented in legacy LORAN systems.

TABLE OF CONTENTS

1.	SCOPE.....	3
2.	REFERENCES.....	3
2.1	Applicable Documents	3
2.1.1	International Telecommunication Union (ITU)	3
2.1.2	National Geospatial-Intelligence Agency (NGA)	3
2.2	Related Publications	3
2.2.1	FAA Publications	3
2.2.2	U.S. Coast Guard Publications	3
2.3	Acronyms	3
2.4	Metric Prefixes	4
2.5	Abbreviations	4
2.6	Symbols	4
2.7	Definitions	4
2.7.1	Antenna Current.....	4
2.7.2	Emission Delay	4
2.7.3	Envelope-to-Cycle Difference	4
2.7.4	Group Repetition Interval	5
2.7.5	Pulse Leading Edge	5
2.7.6	Site	5
2.7.7	Standard Zero Crossing	5
2.7.8	Station	5
3.	eLORAN SIGNALS	5

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Documents
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4.	TRANSMITTED PULSE	6
4.1	Pulse Leading Edge	6
4.1.1	ECD	6
4.1.2	Half-Cycle Peak Amplitudes and Ensemble Tolerance	7
4.1.3	Half-Cycle Peak Amplitudes and Individual Tolerances	8
4.1.4	Pulse Trailing Edge	8
4.1.5	Zero Crossing Times and Tolerances Within a Pulse	8
4.1.6	Spectrum	9
4.2	Pulse Groups	10
4.2.1	GRI	10
4.2.2	UTC Time of Coincidence	10
4.2.3	Timing of Pulse Group	10
4.2.4	Timing Stability of Transmitted Signal	10
4.2.5	Pulse Group Phase Coding	10
4.2.6	Pulse-to-Pulse Amplitude Tolerance	11
4.2.7	Pulse-to-Pulse ECD Tolerance	11
4.2.8	Pulse-to-Pulse Timing Tolerances	11
4.2.9	Out of Tolerance (OOT)	11
5.	DATA CHANNEL	11
6.	NOTES	12
6.1	Revision Indicator	12
Figure 1	TDMA scheme with GRI and ED	5
Figure 2	eLoran pulses with ECDs of -2.5, 0, and +2.5 μ s	7
Figure 3	Zero crossing times and labels for half-cycles	8
Table 1	Zero crossing times (with respect to Standard Zero Crossing) and tolerances	9
Table 2	eLoran pulse group phase codes	10

1. SCOPE

This transmitted eLoran signal standard provides technical descriptions of the waveform, specifications, and explanations. The data channel, receiver specification, and recommended practices are described in the SAE9990 family of standards.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 International Telecommunication Union (ITU) Publications

Available from ITU Publications, sales@itu.int, Tel: 41-22-730-6141, <https://www.itu.int/en/publications/Pages/default.aspx>.

ITU-R TF.460-6 Standard-frequency and time-signal emissions

ITU-R M.589-3 Technical characteristics of methods of data transmission and interference protection for radionavigation services in the frequency bands between 70 and 130 kHz

2.1.2 National Geospatial-Intelligence Agency (NGA) Publications

Available from NGA Public Affairs, publicaffairs@nga.mil, Tel: 571-557-5400, <http://earth-info.nga.mil>.

World Geodetic System 1984 (WGS 84)

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

Loran's Capability to Mitigate the Impact of a GPS Outage on GPS Position, Navigation, and Time Applications

2.2.2 U.S. Coast Guard Publications

Available from the Director of Commercial Regulations and Standards (CG-5PS) U.S. Coast Guard Headquarters, 2703 Martin Luther King Jr. Ave SE, STOP 7126, Washington, DC 20593-7126, Tel: 202-372-1351.

Commandant Instruction M16562.4A Specification of the Transmitted Loran-C Signal

2.3 Acronyms

ECD	Envelope to Cycle Difference
ED	Emission Delay
eLoran	Enhanced Loran
GNSS	Global Navigation Satellite System

GPS	Global Positioning System
GRI	Group Repetition Interval
ITU	International Telecommunication Union
LDC	Loran Data Channel
LORAN	LOng-RANge Navigation
OOT	Out of Tolerance
PC	Phase-Code
PCI	Phase-Code Interval
PNT	Positioning, Navigation, and Timing
TDMA	Time Division Multiple Access
UTC	Coordinated Universal Time

2.4 Metric Prefixes

k	kilo
μ	micro
n	nano

2.5 Abbreviations

Hz	hertz
s	second

2.6 Symbols

π	pi constant
τ	tau

2.7 Definitions

2.7.1 ANTENNA CURRENT

The signal at the transmitting site taken from the transmitting antenna's ground return, which is used to monitor and measure the eLoran pulse.

2.7.2 EMISSION DELAY

The interval of time in microseconds (μ s) between the start of transmitter n's time slot and the start of the first transmitter's time slot.

2.7.3 ENVELOPE-TO-CYCLE DIFFERENCE

The time relationship between the phase of the carrier and the time origin of the envelope waveform.