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STANAG 4369 PCS (EDITION 1) - DESIGN REQUIREMENTS FOR INDUCTIVE SETTING OF ~~ELECTRONIC~~ PROJECTILE FUZES
LARGE CALIBRE

Reference:
AC/310-D/108 dated 12 February 1993

1. The enclosed NATO Standardization Agreement which has been ratified by nations as reflected in page iii is promulgated herewith.

2. The reference listed above is to be destroyed in accordance with local document destruction procedures.

3. AAP-4 should be amended to reflect the latest status of the STANAG.

ACTION BY NATIONAL STAFFS

4. National staffs are requested to examine page iii of the STANAG and, if they have not already done so, advise the Defence Support Division, IS, through their national delegation as appropriate of their intention regarding its ratification and implementation.

G.B. FERRARI
Major-General, ITAF
Chairman, MAS

Enclosure:
STANAG 4369 (Edition 1)

STANAG 4369
(Edition 1)

NORTH ATLANTIC TREATY ORGANIZATION

(N A T O)

MILITARY AGENCY FOR STANDARDIZATION

(M A S)

STANDARDIZATION AGREEMENT

LARGE CALIBRE

SUBJECT: DESIGN REQUIREMENTS FOR INDUCTIVE SETTING OF ~~ELECTRONIC~~ PROJECTILE FUZES

Promulgated on 28 October 1996

G.B. FERRARI
Major General, ITAF
Chairman, MAS

STANAG 4369
(Edition 1)

RECORD OF AMENDMENTS

N°	Reference/date of amendment	Date entered	Signature
1		22.11.04	[illegible]

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Chairman MAS under the authority vested in him by the NATO Military Committee.

2. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

DEFINITIONS

4. Ratification is "The declaration by which a nation formally accepts the content of this Standardization Agreement".

5. Implementation is "The fulfilment by a nation of its obligations under this Standardization Agreement".

6. Reservation is "The stated qualification by a nation which describes that part of this Standardization Agreement which it cannot implement or can implement only with limitations".

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

7. Page (iii) gives the details of ratification and implementation of this agreement. If no details are shown it signifies that the nation has not yet notified the tasking authority of its intentions. Page (iv) (and subsequent) gives details of reservations and proprietary rights that have been stated.

Agreed English/French Text

STANAG 4369
(Edition 1)

NAVY/ARMY/AIR

NATO STANDARDIZATION AGREEMENT
(STANAG)

LARGE CALIBRE

DESIGN REQUIREMENTS FOR INDUCTIVE SETTING OF ~~ELECTRONIC~~ PROJECTILE FUZES

Annexes:
A - Definitions and abbreviations
B - Message characteristics
C - General Fuze-specific parameters

Related Documents:

- STANAG 2916 Nose Fuze Contours and Matching Projectile Cavities for Artillery and Mortar Projectiles.
- AOP-22 Design Criteria and Test Methods for Inductive Setting of Electronic Projectile Fuzes.

AIM

1. The aim of this agreement is to achieve interoperability among the NATO forces in the setting of inductively settable large caliber projectile fuzes. This agreement is not intended to cover tank and mortar ammunition.

AGREEMENT

2. Participating nations agree to comply with the requirements of this STANAG. Design criteria and test methods are given in AOP-22 for the development of inductively settable projectile fuzes and weapon inductive fuze setting systems in respect to the following:

(a) Inductive setting interface
(b) Talk-forward message format
(c) Talk-back message format
(d) Fuze sensitivity to inductive signal
(e) Inductive signal power levels
(f) General physical layout

(g) Functional requirements of the setter.
(h) Functional requirements of the fuze.

DEFINITIONS AND ABBREVIATIONS

3. The definitions and acronyms of terms used in this STANAG will be found in Annex A.

GENERAL

4. Electronic Fuzing is becoming more important in current and future developments. These fuzes in many cases incorporate an autoset capability. To ensure interoperability between these fuzes and the NATO weapon systems, autosetting standards are required.

5. This STANAG provides sufficient detail to define interchangeable message patterns. Design guidance intended to ensure interoperability is defined in AOP-22. The inductive setting system will not degrade or circumvent fuze safety.

6. Interoperability with other fuzes and fuze setters is the responsibility of the development activity or nation. The development activity or nation shall register fuze bit patterns and fuze specific parameters with the custodian who will provide the necessary fuze ID code and list this information in AOP-22.

7. In a tactical situation the fuze is mounted on a projectile when presented to the setter. The setter receives information for the particular fire mission from the external operator or fire control system, and then sets the fuze through the inductive interface. The fuze repeats the message back through the inductive interface and the setter compares the two transmissions.

8. Figure 1 is a pictorial representation of a possible physical layout. It comprises a nose fuzed artillery projectile and a setter. This STANAG places requirements on the inductive link utilizing the coil of wire located in each item. It depicts the setter's transmit coil, the fuze's receive coil, the magnetic coupling between the two, and a typical relative position. Multiple coil configurations are also acceptable.

9. Communication structure comprises a power up period (PUP) and one or more fuze message windows (FMW). The timing diagram is illustrated in figure 2.

10. Setter and fuze specific message and timing characteristics are provided in AOP-22.

11. The communication format requires message error detection by the setter. This feature is provided by the setter

transmitting a message to the fuze, for the fuze to repeat the message back to the setter, and for the setter to compare the two transmissions.

12. The fuze may be programmed in two modes. The set mode is used to program inductively set fuzes at the launch platform in tactical situations. Use of this mode requires the operator to know the identity of the fuze being set and requires the inductive fuze setter to know all of the timing and bit pattern requirements applicable to the fuze being set. The command mode can be used for several functions such as fuze interrogation and fuze calibration. The setter will transform specified information transmitted to the operator into a form similar to that of the original fire mission data. Specific transformations are detailed in AOP-22.

13. The units used in all Figures and Annexes conform to the International System (SI) of metric units except those specifically designated otherwise.

DETAILS OF THE AGREEMENT

14. The fuze physical layout shall include a coil of wire configured such that the magnetic field from the setter's coil will be sufficient to set the fuze, when mounted on the artillery projectile and located in the tactical position, in accordance with this STANAG. Fuze nose contours are governed by STANAG 2916. Rotation of the fuze about its axis shall not affect its interaction with any setter.

15. The setter physical layout shall include a coil of wire configured such that the setter can set the fuze when the fuze is mounted on the artillery projectile and in accordance with this STANAG. If a specified setter function is implemented by components physically located within the fire control system or other element, then any reference to the setter shall also apply to those components.

16. The setter shall receive, from the operator or fire control system, the information necessary to set the fuze for the fire mission. The setter shall then, in a format appropriate for the fuze being set and the fire mission, transmit a complete message to the fuze. The setter shall then detect the information returned by the fuze and compare it to the originally transmitted information. The setter shall indicate to the operator or fire control system the status of the fuze.

17. The fuze shall receive a message from the setter in a format appropriate for the fuze and the fire mission. The fuze shall then transmit a specified message to the setter. The fuze mission memory shall change as specified.

18. Communication between setter and fuze shall be accomplished by digital coding and modulation of the carrier. Digital coding and modulation is implemented with mark and space phases for messages as specified. The setter modulates the carrier by energizing and de-energizing its coil. The fuze modulates the carrier by changing the impedance across its coil and thereby affects voltage and current in the setter coil. Message characteristics shall comply with the requirements in Annex B.

19. The values of a number of fuze parameters associated with the inductive interface shall be selected by the development activity. The values selected shall be within the range permitted by this STANAG for each such parameter. The development activity is responsible for parameter selection appropriate to support the interoperability requirements of the fuze. The development activity shall request an identification (ID) code assignment from the custodian. Requirements for general fuze parameters are given in Annex B and herein. Fuze specific parameters are provided in AOP-22.

20. All fuzes shall be settable with repeated fuze message windows in accordance with figure 2. Sequential forward messages may contain the same or different bit patterns.

21. All message timing parameters shall be in accordance with the specific requirements of the fuze to be set.

22. When the first bit of the ID code is a "0", then bits 1 through 5 comprise the entire ID code. When there are multiple Fuze Message Windows (FMWs), the first bit of the ID code shall be a "1". The first FMW shall begin with an ID code followed by data, and successive FMWs, if needed, shall begin with a byte count instead of the ID code.

23. When the first bit of the ID code is a "1", then the ID code is expanded, and bits 6 through 8 become additional ID bits.

24. The first FMW shall contain a forward and reverse message with an ID code that is correct for the fuze to be set. Subsequent FMWs shall contain a forward and reverse message with a four-bit byte count located in the first five-bit positions of each FMW (see figure 3). The data portion of the forward message shall comprise a bit pattern as specified (see AOP-22). The forward message is generated by the setter and the reverse message is generated by the fuze.

25. The setter shall compare the forward message with the reverse message on a bit-for-bit basis in each FMW. If the bit-for-bit comparison fails, then the setter shall so inform the operator. The setter may automatically make two more attempts to achieve a successful comparison before indicating a failure.

26. Multiple FMWs shall be sent in sequential order unless an error occurs, in which case the incorrect FMW can be immediately retransmitted up to two additional times.

27. The fuze shall examine the bit pattern in the forward message of the first FMW and reject the message containing an ID code that is not registered with the fuze or which contains fewer bits than are proper for the fuze.

28. If the forward message is accepted by the fuze, then the reverse message data bit pattern shall be identical to that of the forward message.

29. If the forward message is rejected by the fuze, then the reverse message data bit pattern shall be indicative of the fuze default mode (see AOP-22).

30. The fuze mission memory shall not be changed by a forward message before the acceptance or rejection of the message has been determined.

31. After receipt of an accepted set mode message and a valid set of FMWs, the fuze mission memory shall be changed to that of the current fire mission. The receipt of an invalid set of FMWs shall cause the fuze to revert to the default mode.

32. After receipt of a rejected set mode message, the fuze mission memory shall be changed to that of the fuze default mode.

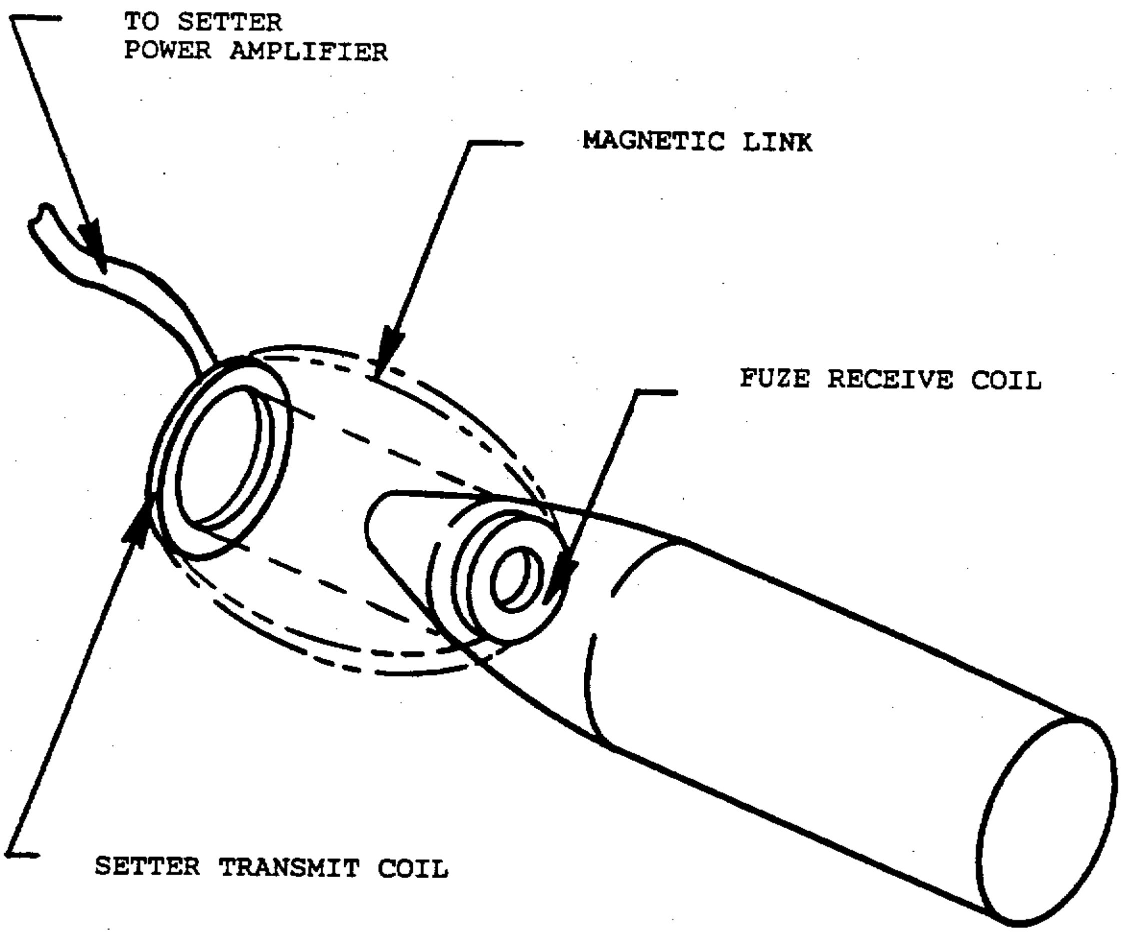
33. Each nation is responsible to:

a. Appoint a Point of Contact (POC) to liase with the Custodian of AOP-22 with respect to the allocation of fuze pattern identifications to their Design Authorities. A list of POCs will be maintained in an Annex to AOP-22.

b. Register with the custodian of AOP-22, through their POC, the identification codes and characteristics of the fuzes and setters in which they are embedded, in accordance with AOP-22, Annex E.

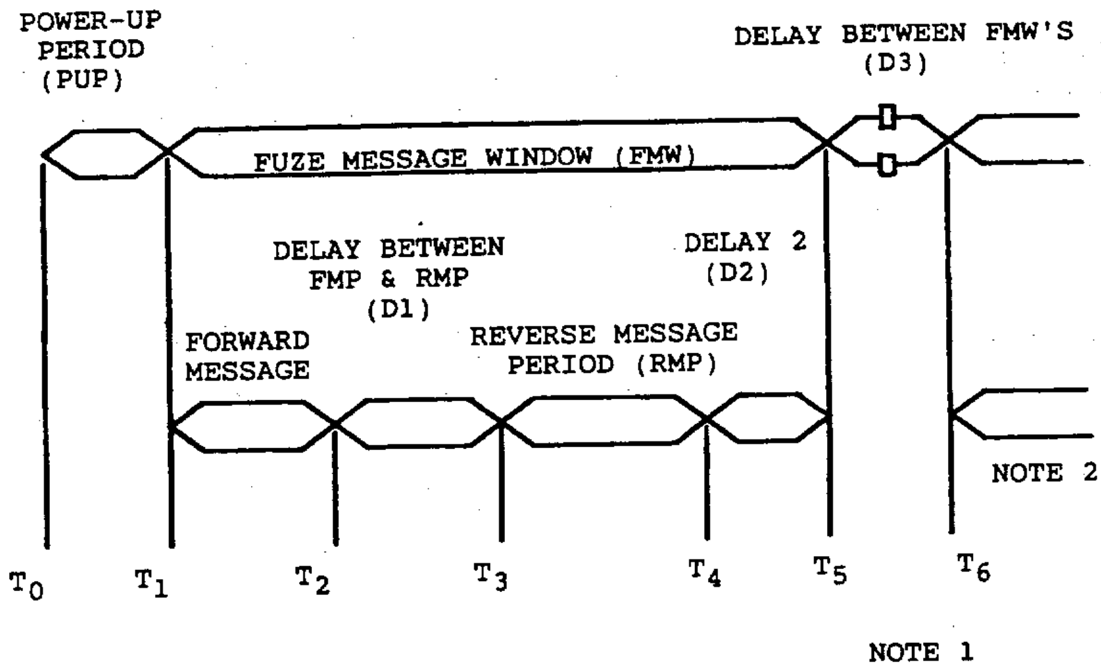
IMPLEMENTATION OF THE AGREEMENT

34. This STANAG is implemented when a nation has issued instructions that all inductively set projectile fuzes and their respective setters will be designed and manufactured in accordance with the specification detailed in this agreement.



Note: The setter coil is shown seperated from the fuze coil to show the magnetic link.

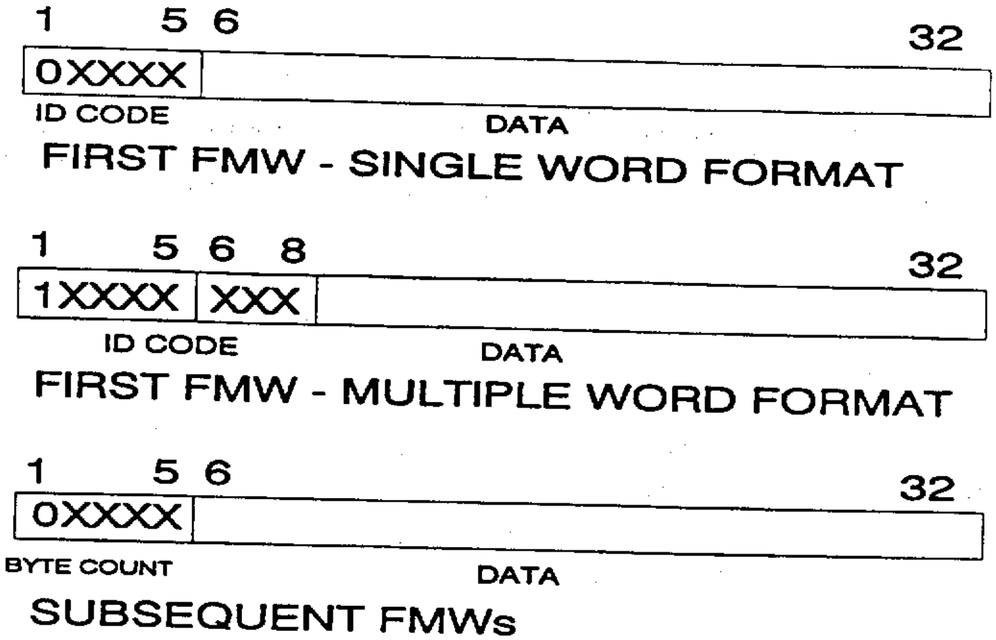
Figure 1. Inductive interface pictorial representation.



NOTES:

1. T5 marks the end of communication and T6 marks the carrier turn-off for a single FMW. (See Annex B, paragraph 1)
2. T1 through T6 sequence would be repeated for additional FMWs.

Figure 2. Inductive interface timing diagram.



Notes: Bits 1 through 5 signify the ID code for fuzes with a single FMW. Bit 1 must be a "0" for fuzes with a single FMW.

Bits 1 through 8 are used for the ID code for fuzes which have a "1" in bit 1. Only fuzes with this expanded ID code can have multiple FMWs.

X indicates a variable bit for an ID code or byte count.

Figure 3. Inductive Word Format.

DEFINITIONS AND ABBREVIATIONS

1. For the purposes of this STANAG, the definitions, terms and acronyms herein shall apply.

2. Carrier. A magnetic field with sinusoidal waveform that is generated by the setter to support two-way information transmission between the setter and the fuze in accordance with this STANAG.

3. Delay 1 (D1). The delay between the FMP and the RMP is termed D1. Delay 1 is used by the fuze to process the forward message and to prepare for talkback to the setter.

4. Delay 2 (D2). Delay 2 is the time interval between the end of the RMP and the end of the FMW. Delay 2 allows a fixed time duration for the FMW to be maintained.

5. Delay 3 (D3). Delay 3 is the time interval between FMW's. Delay 3 is used by both fuze and setter to prepare for the next FMW.

6. Duty cycle. For a periodic waveform, the ratio of the mark phase to the total period of the waveform. It is expressed as a percentage. The space phase is that part of the waveform which is not mark phase.

7. Forward message. The message transmitted from the setter to the fuze in any fuze message window.

8. Forward message period (FMP). The time required to transmit a forward message and is the product of the number of bits in the forward message and the reciprocal of the forward message bit rate.

9. Fuze default mode. A functional mode of operation that the fuze specification defines if an improperly set fuze is fired.

10. Fuze message window (FMW). A fixed time comprising the forward message period, the reverse message period, the interval between them, and Delay 2.

11. Fuze mission memory. That part of the fuze which remembers the setting information for a fire mission after the inductive setting process is completed.

12. Fuze-specific parameters. The bit pattern and timing parameters identified for a particular type of fuze.

13. Identification code (ID). The five-bit or eight-bit code assigned by the registering activity to each fuze. A single ID code is generally, but not necessarily, associated with a single fuze. Fuzes with identical functional modes, missions, and fuze-specific parameters should utilize the same fuze identification code.

14. Inductive fuze setter. A device which utilizes an inductive interface to exchange data with an inductively settable fuze in compliance with this STANAG and AOP-22. The fuze setter may interpret the significance of individual data bits received and display the interpreted information to the operator.

15. Inductive interface. The characteristics that control the interaction of an inductive fuze setter with an inductively settable fuze, in accordance with this STANAG.

16. Inductively settable fuze. A fuze that can be set with an inductive fuze setter using the inductive interface.

17. Mission message. The mission message is composed of the data bits which identify fuze function and provides fuze function-specific information. The mission message is composed of one or more FMWs.

18. Power-up period (PUP). A prescribed period of time during which the inductive fuze setter energizes, with a sinusoidal waveform magnetic field, the physical space between the setter and the fuze. This period permits an inductively settable fuze to absorb sufficient energy from the magnetic field to operate necessary fuze circuits.

19. Reverse message. The message transmitted from the fuze to the setter in any fuze message window.

20. Reverse message period. The time interval during which an inductively settable fuze transmits a reverse message to the fuze setter. It is the product of the number of bits in the reverse message and the reciprocal of the reverse message bit rate.

21. Valid message. A message that contains the correct number of FMWs transmitted in the correct order.

MESSAGE CHARACTERISTICS

1. The setter controls the energizing of its coil. After the PUP, the setter transmits a forward message and then continues energizing its coil through the end of the communication. If more than one FMW is used, then there will be a delay (termed D3) between each FMW. The setter terminates the carrier within D3 after the end of the last FMW.

2. A forward message consists of a sequence of bits transmitted by the setter. The forward message bit rate is specified in table B-1. Identification of logic 1's and 0's is based on the duty cycle of the waveform measured. Mark is represented by absence of carrier. A space is represented by presence of carrier. Figures B-1 and B-2 illustrate waveforms associated with forward message bits.

3. A reverse message consists of a sequence of bits transmitted by the fuze. The reverse message bit rate is controlled by the fuze and will be within the range specified in table C-1. Identification of logic 1's and 0's is based on the duty cycle of the waveform. Mark is represented by varying the impedance "shorting cycle" across the fuze receive coil at a frequency (subcarrier) of 32 times the bit rate. The impedance reduction cycle is synchronized to the start of the mark period. Space is represented by restoring the impedance across the fuze receive coil. Figure B-3 illustrates waveforms associated with reverse message bits.

4. General inductive setting parameters are specified in table B-1.

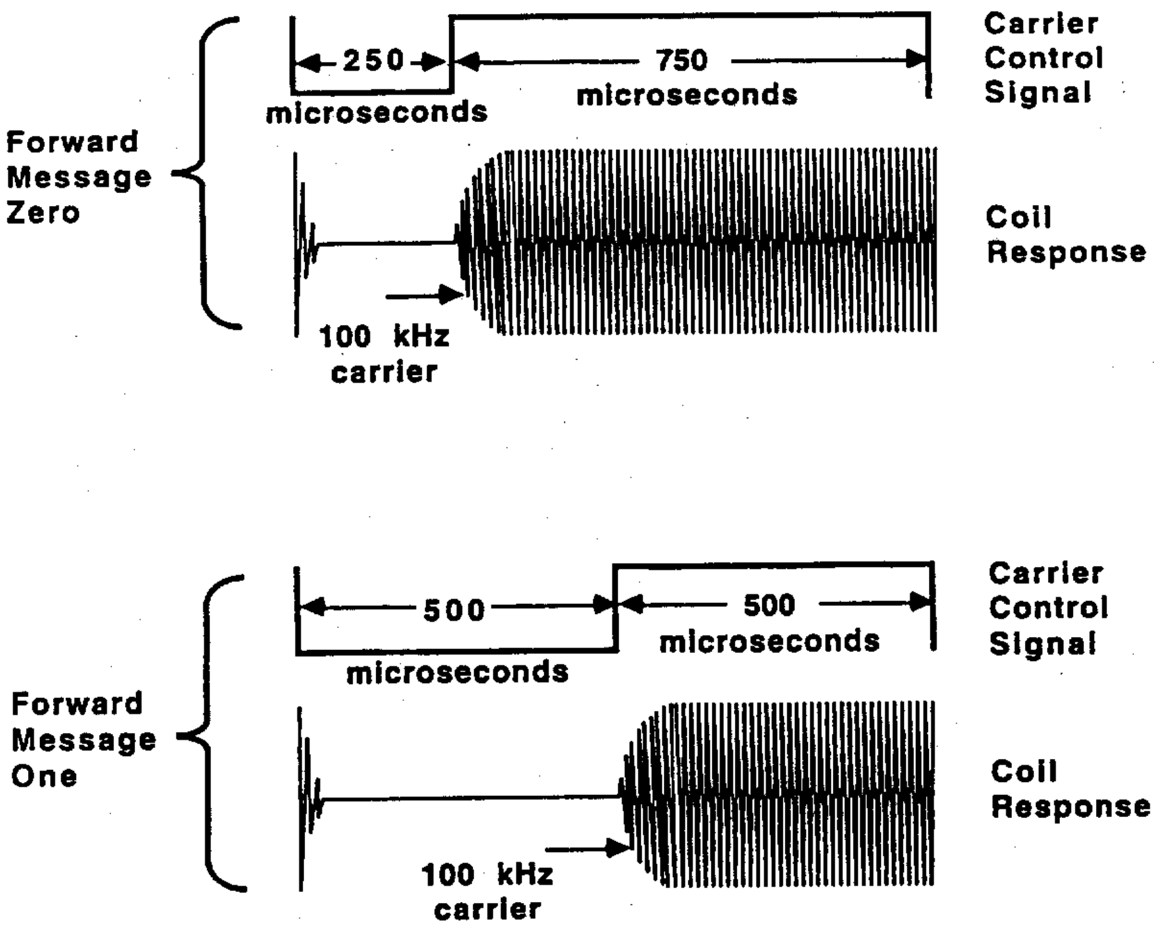
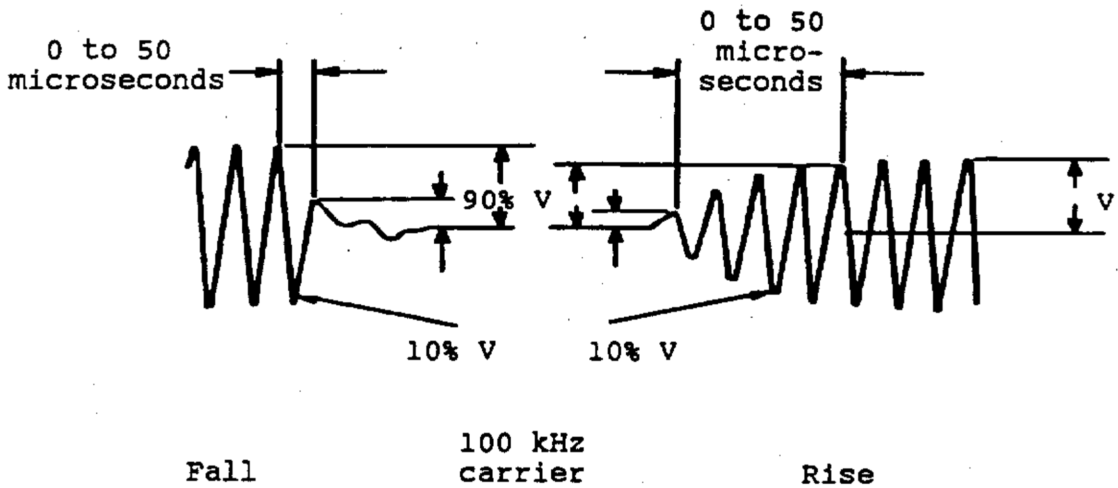
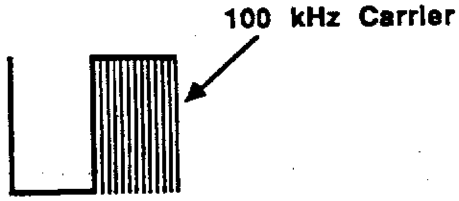


Figure B-1. Forward message: bit general characteristics

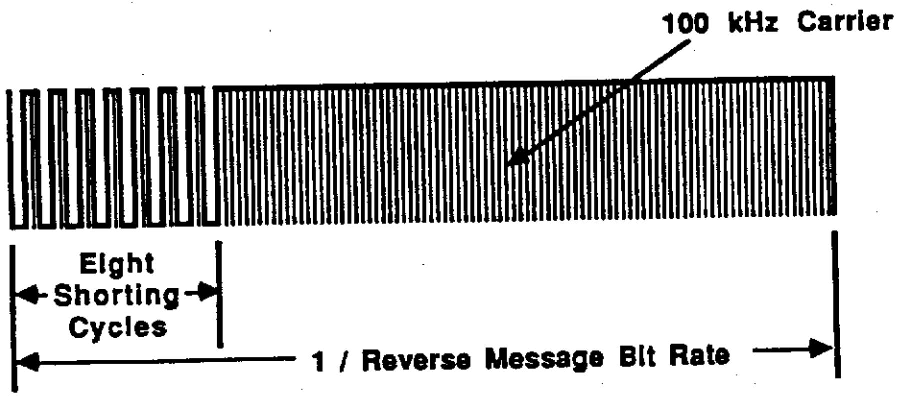


Note: Waveform measured across the Standard Fuze coil.

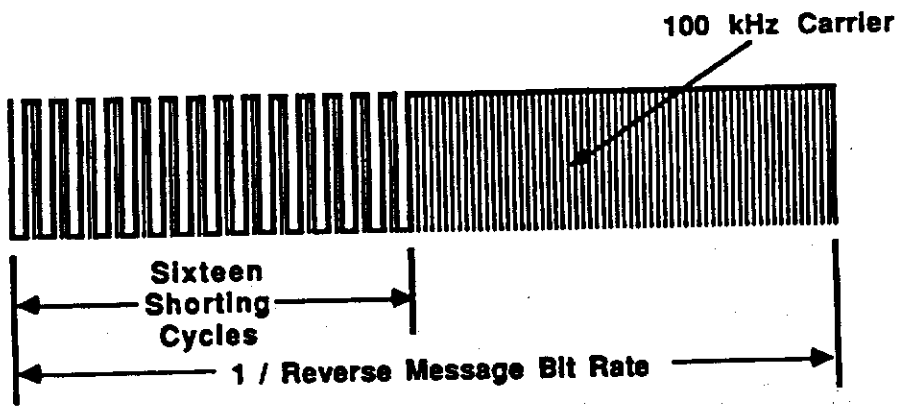
Figure B-2. Forward message: bit rise time and fall time characteristics.



a. Single shorting cycle



b. Reverse message "0"



c. Reverse message "1"

Figure B-3. Reverse message: fuze coil bit characteristics.

PARAMETER	VALUE	UNITS	REFERENCE
FMW	275 +/- 5	ms	figure 2
D1	3 min, 50 max	ms	figure 2
D2	230 maximum	ms	figure 2
D3	50 maximum	ms	figure 2
carrier frequency	100 +/- 0.01	kHz	
forward message bit			
rate	1000 +/- 10	bits/s	figure B-1
rise time (mark-to-space)	50 max	µs	figure B-2
fall time (space-to-mark)	50 max	µs	figure B-2
logic 0 mark	250 +/- 5	µs	figure B-1
logic 0 space	750 +/- 5	µs	figure B-1
logic 1 mark	500 +/- 5	µs	figure B-1
logic 1 space	500 +/- 5	µs	figure B-1
reverse message bit			figure B-3
reverse message bit rate	120 to 165	bits/s	
shorting cycle frequency	32 x bit rate	Hz	Annex C
shorting cycle phase	start with short		figure B-3
shorting duty cycle	50 +/- 5	percent	
shorting cycle logic 0	8	cycles	figure B-3
shorting cycle logic 1	16	cycles	figure B-3

Table B-1. General Inductive Setting Parameters

GENERAL FUZE-SPECIFIC PARAMETERS

1. The bits in an FMP shall comprise a start bit (if used), ID bits or byte count, and data bits. The maximum number of bits in a FMP shall be 32 without a start bit, and 33 with a start bit. Use of a start bit causes the forward message to be one bit longer than the reverse message.

a. A start bit (if used) shall precede the ID code in a FMP, and is always a logic 1. A start bit shall not be echoed back by the reverse message.

b. ID bits or byte count shall precede the data bits in both the FMP and the RMP.

c. The number of data bits in one FMW for any fuze shall be no more than 27.

d. Fuzes may utilize fewer than 32 bits in each FMW.

2. Fuze-specific parameters are specified in table C-1. Additional fuze parameters are provided in AOP-22.

PARAMETER	VALUE	UNITS	REFERENCE
Carrier frequency	100 +/- 0.01	kHz	figure 2
PUP	1 min, 1000 max	ms	figure 2
D1	3 min, 50 max	ms	figure 2
D2	NOTE 1	ms	figure 2
D3	50 max	ms	figure 2
ID bits	five-bit or eight-bit code		
Start bit	yes/no		
Data bits		number	
FMP	NOTE 2	ms	figure 2
Reverse message bit rate	120 min, 165 max	bits/s	figure B-3
RMP	NOTE 3	ms	figure 2
FMW number	1 min	number	
Subcarrier frequency	4560 +/- 720	Hz	

Table C-1. Fuze-specific Parameters

NOTES:

1. D2 is given by FMW minus (FMP plus D1 plus RMP) and may be any non-negative value corresponding to permitted values of FMW, FMP, D1, and RMP.

2. FMP is given by the number of forward message bits divided by the forward message bit rate.

3. RMP is given by the number of reverse message bits divided by the reverse message bit rate.