P R I M E I T E M P R O D U C T F U N C T I O N S P E C I F I C A T I O N

F O R T H E K E Y L E S S

M A I N G U N S I G N A T U R E S I M U L A T O R

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prepared under Cubic contract no.: D66110LC

SDRL B005-002

Prepared by: Cage Code D 1 3 4 7

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Prepared Program Manager

Table of Content

1. SCOPE

1.1 Scope. This specification establishes the performance design, test, manufacture, and acceptance requirements for the Main Gun Signature Simulator prime item.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents

2.2.1 Specifications, Standards and Handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein.

STANDARDS:

MILITARY

MIL-STD-130- Identification Marking of U.S. Military Property
Rev. H, 11 Dec. 93

MIL-STD-454 Standard General Requirement For Electronic Equipment
Rev. N, Notice 3, 22. Sep 94

MIL-STD-810- Environmental Test Methods and Engineering Guidelines
Rev. E, Notice 2, 1 Sept. 93

MIL-STD-1472 - Human Engineering
Rev. D, Notice 3, 10 Feb. 94

MIL-STD-1474 - Noise Limits for Military Material (METRIC)
Rev. C, Notice 1, 30 Jul. 93

HANDBOOKS:

MILITARY

MIL-HDBK-759 - Human Factors Engineering Design for Army Material
Rev. B, 30 Jul. 92

(Unless otherwise specified, copies of federal and military specifications, standards and handbooks are available through the DOD Single Stock Point: Standardization Document Order Desk, Building 4, Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2.2 Other Government Documents, Drawings and Publications. The following Government documents, drawings and publications form a part of this document to the extent specified herein. In the event of conflict between this specification and the referenced Performance Specification for the Main Gun Signature Simulator (MGSS), the Performance Specification shall take place.

AMSTE Test Operations Procedure (TOP) 1-2-511 29 Dec. 89	-	Intersystem Electromagnetic Capability Requirements, System Testing
19200-DS-138 1 Apr. 94 and Mod P00013	-	Critical Item Development Specification for Audio/Visual Cue Pyrotechnic Simulator
AMSTI-93-S026 1 Apr. 94 and Mod P00013	-	Performance Specification For The Main Gun Signature Simulator (MGSS)
FED-STD-595 Rev 5, 15. May 89	-	Colors Used In Government Procurement
ANSI/IPC-D-275 Sep 91	-	Design Standard For Rigid Printed Boards And Rigid Printed Board Assemblies
ANSI/IPC-RB-276. Amendment 1 Nov 94	-	Qualification And Performance Specification For Rigid Printed Boards

DRAWINGS

U.S. ARMY SIMULATION, TRAINING AND INSTRUMENTATION COMMAND (STRICOM - Code 57039)
Product Drawings

148200-2	KIT, MGSS
149106-2	Interface Control Drawing Firing Unit, MGSS
149102-2	Interface Control Drawing Fire Control Unit, MGSS
149103-1	Interface Control Drawing Cable Assy FCU/FU
148764-1	Interface Control Drawing Cable Assy DC Power

U.S. ARMY ARMAMENT RESEARCH DEVELOPMENT AND ENGINEERING CENTER (ARDEC - Code 19200)
Product Drawings

12978533	AVCPS, MGSS, M30 (pyrotechnic cartridge)

(Unless otherwise specified, copies of Government documents, drawings and publications are available through the Naval Air Warfare Center Training Systems Division, Code 27322, 12350 Research Parkway, Orlando, FL 32826-3276.)

2.3 Non-Government Publications. The following documents form a part of this document to the extent specified herein.

GERMAN MILITARY STANDARDS

VG95234 Issue Jan. 92	-	Elektrische Steckverbinder mit Bajonettkupplung (Electrical Connectors with quarter-turn fastener)

(Application for copies should be addressed to Beuth Verlag GmbH, 10772 Berlin, Germany)

DIEHL LUFTFAHRT ELEKTRONIK DOCUMENTS

Doc.No.: 9721803	The Operating and Support Hazard Analysis (O&SHA) for the keyless Main Gun Signature Simulator (MGSS), Direct / Indirect Fire Cue (DIFCUE) and the Audio Visual Cue Pyrotechnic Simulator (MILES 2000 SDRL #A00F)
Doc.No.: 9719201	Acceptance Test Procedure for the MILES 2000 MGSS & DIFCUE

(Application for copies should be addressed to DIEHL LUFTFAHRT ELEKTRONIK, Heinrich-Diehl-Str. 2; 90552 Roethenbach, Germany)

2.4 Order of Precedence. In the event of a conflict between this document and the references cited herein, the AMSTI-93-S026 Performance Specification shall be first in precedence followed by this document. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 MGSS Definition. The MGSS is an electro-mechanical device that is installed on a vehicle and simulates main gun fire by pyrotechnic means during force-on-force training exercises. The simulation exhibits aural (noise) and visual (flash and smoke) characteristics detailed in AMSTI-93-S026.

3.1.1 MGSS Block Diagrams. The MGSS system is shown in block diagram Figure 1.

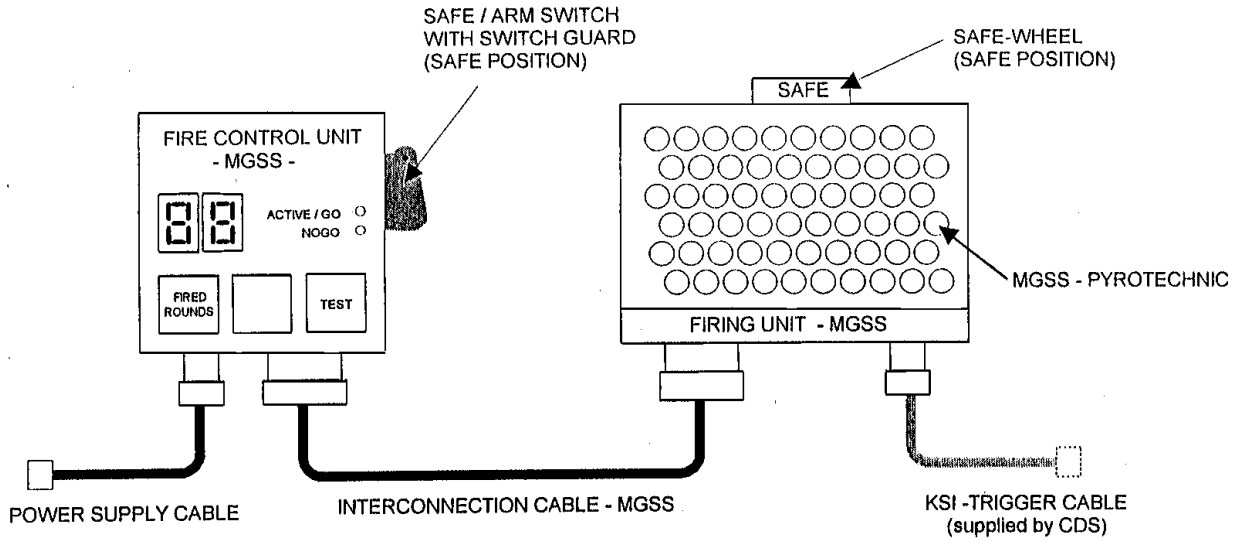

Figure 1: Block diagram for the MGSS system

3.1.2 MGSS Pyrotechnic Definition. The MGSS pyrotechnic consists of the MGSS Audio/Visual Cue Pyrotechnic Simulator (AVCPS/MGSS). The MGSS pyrotechnic cartridge is not part of the MGSS Kit and is ordered, packed and shipped separately from the MGSS Kits. The MGSS must use only the special pyrotechnic cartridges M30 (AVCPS, MGSS per ARDEC Dwg. 12978533) that were designed for this device. The pyrotechnic cartridges are manually loaded/unloaded into the MGSS device. There is no spent cartridge ejection.

3.1.3 Major Component List. The MGSS consists of a Fire Control Unit (FCU), a Firing Unit (FU) for 60 shots, a Cable Assy DC Power, a Cable Assy FCU/FU and a Velcro Fastener Tape (for FCU). The MGSS Kit shall comply with all requirements specified on drawing 148200, and all associated drawings, and with all requirements specified in applicable specifications and standards

3.2 Characteristics. The following subparagraphs describe the performance and physical characteristics of the MGSS.

3.2.1 Performance Characteristics. The major subassemblies of the MGSS system are shown in Figure 2, and a functional diagram is shown in Figure 3.

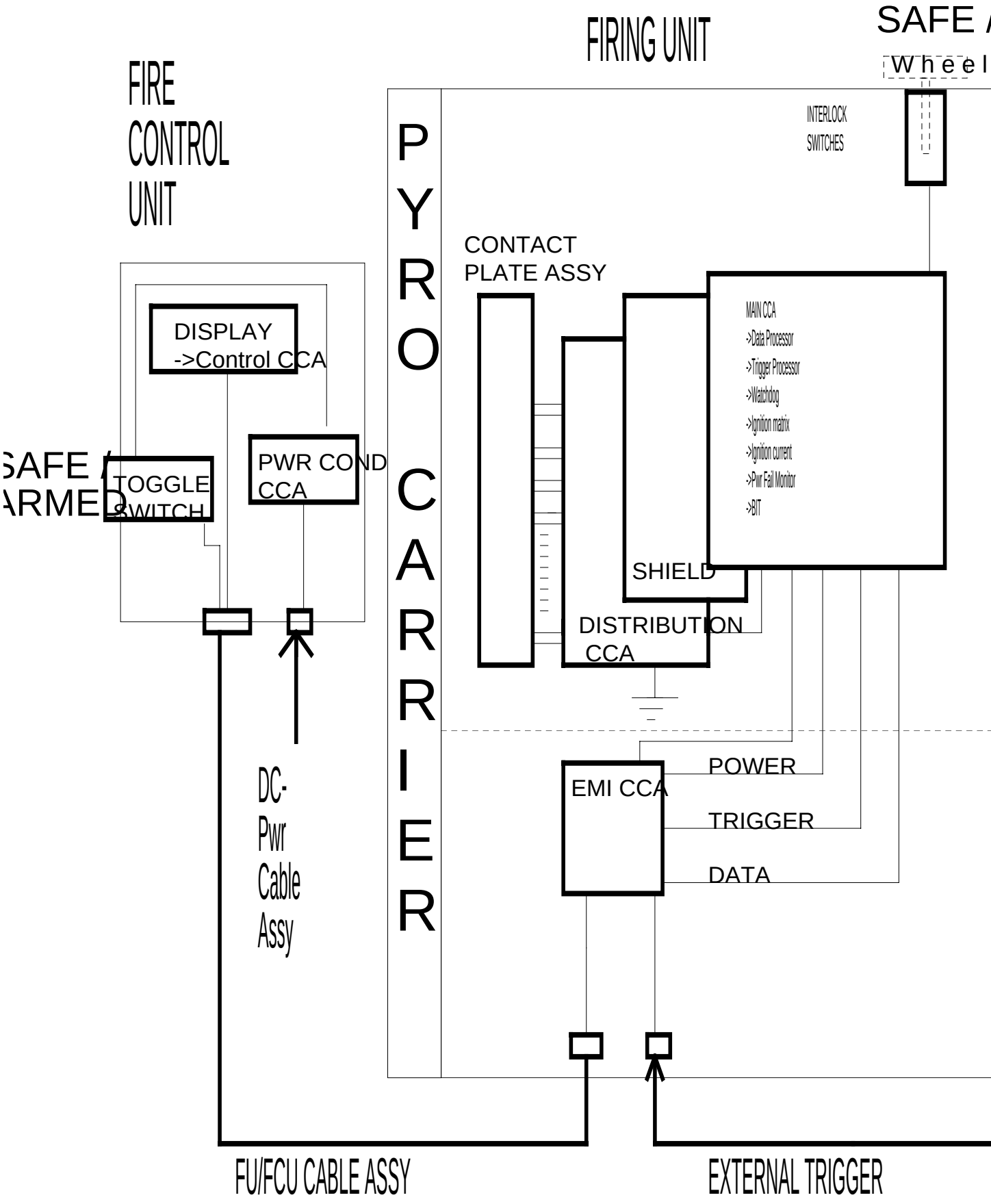
FIRING UNIT
SAFE /
Wheel
FIRE
CONTROL
UNIT
PYRO CARRIER
INTERLOCK
SWITCHES
CONTACT
PLATE ASSY
MAIN CCA
->Data Processor
->Trigger Processor
->Watchdog
->Ignition matrix
->Ignition current
->Pwr Fail Monitor
->BIT
DISPLAY
->Control CCA
SAFE /
ARMED
TOGGLE
SWITCH
PWR COND
CCA
SHIELD
DISTRIBUTION
CCA
DC-
Pwr
Cable
Assy
EMI CCA
POWER
TRIGGER
DATA
FU/FCU CABLE ASSY
EXTERNAL TRIGGER

Figure 2: MGSS Block Diagram

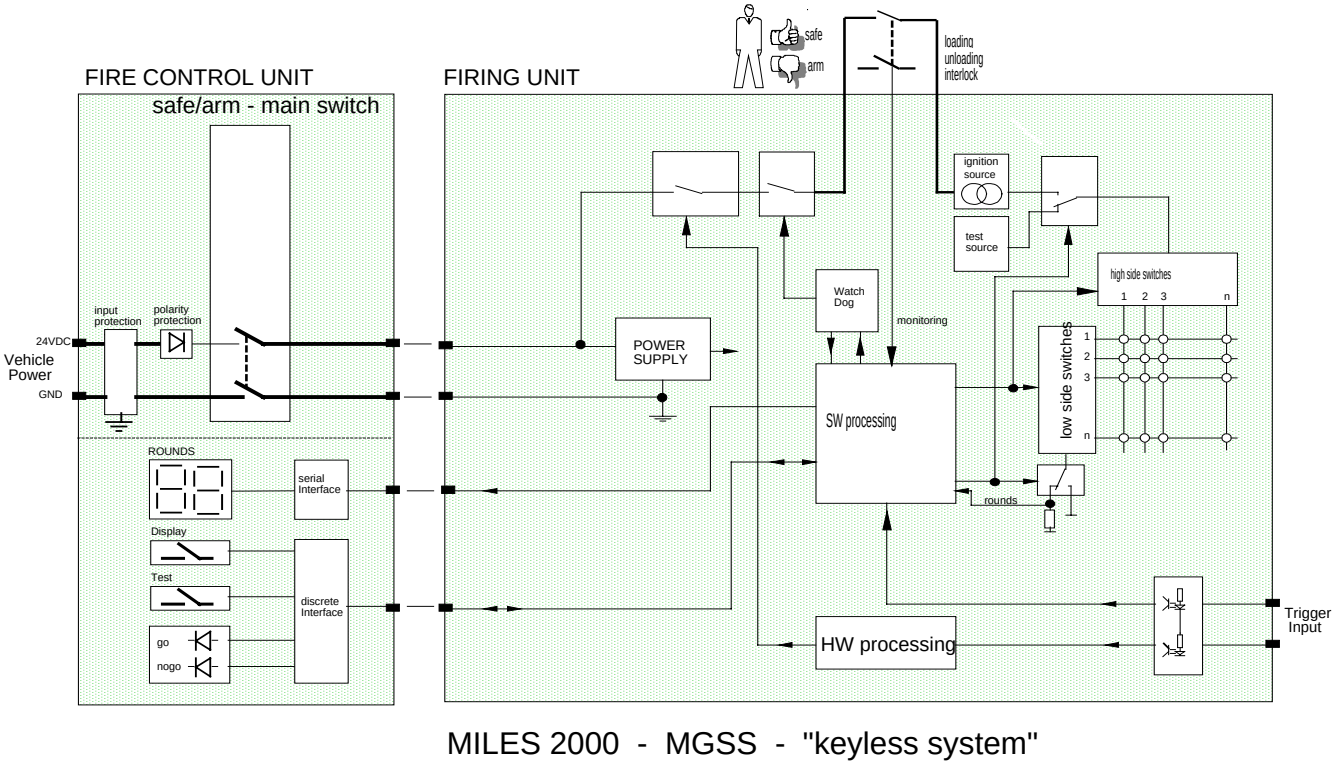

Figure 3: MGSS Functional Block Diagram

Normal functional sequence of the MGSS system:

1) System is installed and ready for operation operation, that means pyrotechnics have been loaded, Safe Wheel of Firing Unit is turned to „ARMED“ position, and SAFE/ARM-Switch of Fire Control Unit is in „SAFE“ position (loading and unloading pyrotechnic see paragraph 3.3.3.6).
2) Put SAFE/ARM-Switch of the FCU to ARMED-position.
3) System starts with a power-on self-test (BIT). During the self-test all display segments are illuminated for a short time.
4) The ACTIVE GO indicator on the FCU will illuminate (green) if no BIT error was detected.
5) The NO GO indicator on the FCU will illuminate (red) if a BIT error was detected. The system will not operate and an error code will be displayed in the „Rounds“ window of the FCU.
6) After a successful self-test and GO indication, the system will count the actual number of rounds (pyros) loaded in the Firing Unit.
7) System will display the actual number of rounds.
8) System is ready and waits for a valid trigger signal.
9) If a valid trigger signal is detected, the activation sequence starts, and then the first pyrotechnic is activated.
10) After activation, the rounds display at the FCU will be automatically updated (decreased by one).
11) Depressing and holding the FIRED ROUNDS button at the FCU will cause the display to change and indicate the number of rounds fired. Depressing the DISPLAY TEST button at the FCU will initiate a self-test (BIT).
12) An incoming trigger signal will interrupt the self-test and begin a normal activation sequence.
13) If vehicle power is interrupted or not available, the system shuts down .
14) When/if vehicle power returns, a system reset is necessary. After reset the system returns to normal operation.
15) The system is normally shut down in a series of steps: putting the SAFE/ARM-Switch at the FCU to the SAFE-position, approach FU from opposite side of the firing direction and turn the SAFE-WHEEL of the FU to SAFE-position. Open the Firing Unit and removing all pyrotechnic cartridges. Close the cartridge carrier of the FU and lock it with the handles on each side. Leave the area of the Firing Unit according the safety distances (3.3.3.2).
If the FU was opened without setting the FCU into SAFE-position, the microprocessor sets the FCU out of function. A reset of the FCU is necessary (see 3.2.1.4).

3.2.1.1 Fire Control Unit (FCU). The FCU is the human interface/control unit for the MGSS system, see Figure 4. The FCU contains the main **"**SAFE/ARM“ switch as well as the display, indicators and pushbuttons for the user interaction with the system. The SAFE/ARM-Switch is the ON-OFF switch for all power to the MGSS.
There is one display, two indicators and two membrane pushbuttons on the Fire Control Unit. They operate as follows:
ACTIVE/GO Indicator (LED):
Continuous green= ``GO“, system OK after passing BIT
Continuous green = ``ACTIVE“, system operational and supplied by vehicle power

NO GO Indicator (LED):
Continuous red = ``NOGO“ after BIT with failure result (error code, see paragraph 3.2.7.4.1)
``NOGO“ after improper „safeing-procedure“, when loading pyrotechnics
Rounds Display (2 character, 7-segment LED’s):
Normal display = number of available pyrotechnic cartridges is displayed.
If ″Fired Rounds″ button is depressed and held = number of fired pyrotechnic cartridges is displayed.
If a continuous red NO GO indicator is illuminated = error code is displayed.
DISPLAY/TEST Button:
If depressed and held for greater than 1 second = BIT is initiated.
FIRED ROUNDS Button:
If depressed and held = causes display to change and show the number of fired rounds, i.e., expended cartridges.

With the SAFE/ARM-Switch of the Fire Control Unit, the system can be switched from the „SAFE“ (OFF) into the „ARMED“ (ON) operation mode (see Figures 4). The SAFE/ARM-Switch has a switch guard. When in SAFE-position (engraved text „SAFE“ and „ARMED“ on FCU frame), the switch is down (see Figure 4-1), in ARMED-position the switch guard is opened and switch lever is pushed up (see figure 4-2). If the switch guard is closed, the switch is forced to the down or SAFE-position.

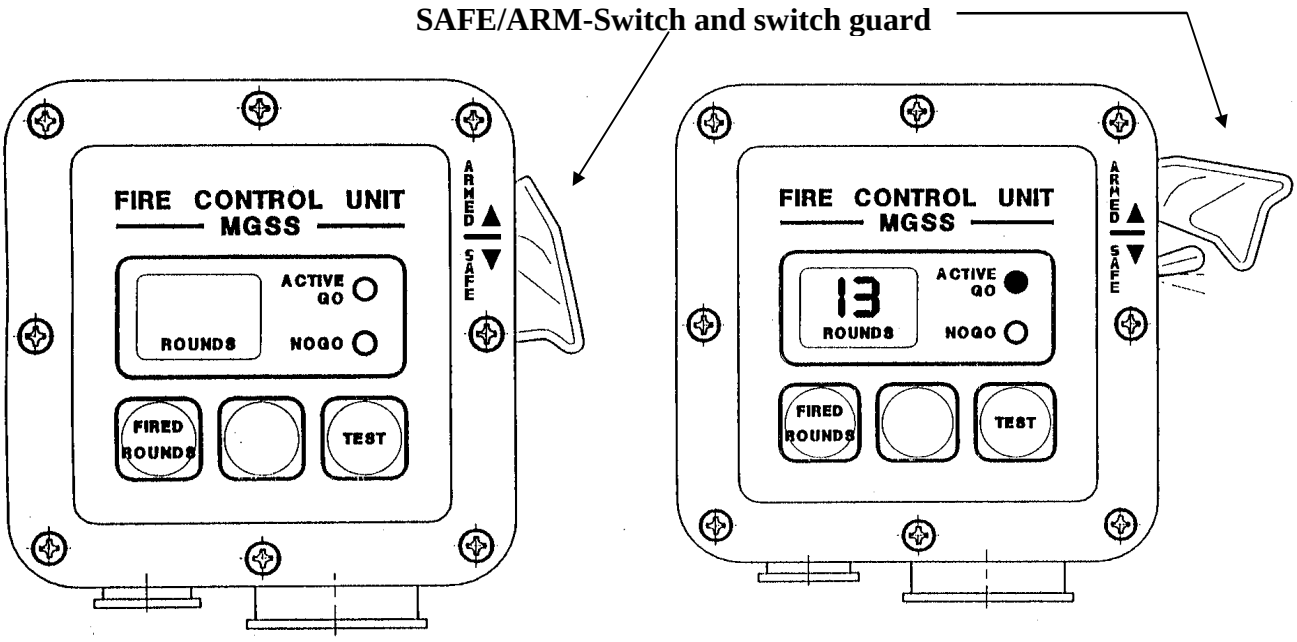

Figure 4-1: Fire Control Unit MGSS „SAFE“ Figure 4-2: Fire Control Unit MGSS „ARMED“

3.2.1.1.1 Indication of Rounds. The Fire Control Unit contains the 2 character (7-Segment-LED) display. The display normally shows the number of remaining live pyrotechnic cartridges. By depressing the ″FIRED ROUNDS″ button and holding it down, the display will change to show the

number of fired or expended pyrotechnic cartridges. When the button is released the display returns to normal.

3.2.1.1.2 Fault Detection. The MGSS contains built-in-test (BIT) capabilities. The BIT is initiated by depressing the DISPLAY/TEST button. System failures of a "NO GO" nature are detected, an error code is displayed, and the system ceases to operate. A description of the BIT and list of error codes is provided in paragraph 3.2.7.4.

3.2.1.2 Firing Unit. The Firing Unit is shown in Figure 5 and 5-1. The Firing Unit is comprised of the main body and the upper hinged pyrotechnic carrier for 60 MGSS pyrotechnic cartridges. The status of fired rounds or available rounds is displayed on the Fire Control Unit (see paragraph 3.2.1.1). The connection of the system is described in paragraph 3.1.1 and 3.2.1.
The Firing Unit (see Figure 5) can be attached to the vehicle adapters via 4 captive screws (see paragraph 3.2.1.12.2). The cartridge carrier (see Figure 5-1) allows reloading of up to 60 MGSS cartridges. The carrier can be locked by lever locking mechanism on two sides.
The aluminum main housing contains the integrated electronics, wiring and after the carrier is in reload position (see Figure 5-1) front removable pyrotechnic contact assys.

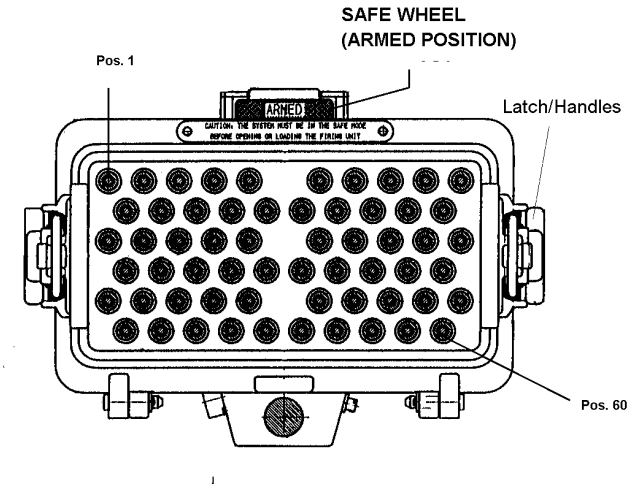

Figure 5: Firing Unit MGSS

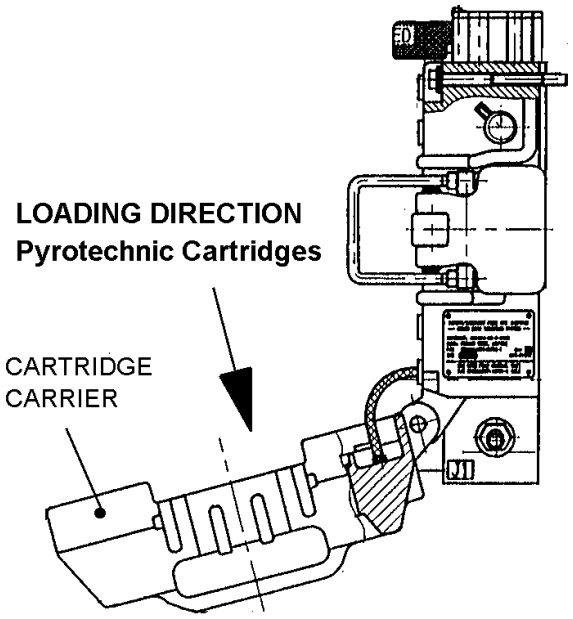

Figure 5-1: Open cartridge carrier

3.2.1.2.1 SAFE-WHEEL. With the SAFE-WHEEL of the MGSS Firing Unit, the Firing Unit can be switched from the „SAFE" operation mode to the „ARMED" operation mode (see Figures 5 to 7). The SAFE-WHEEL has a red (ARMED) and a green (SAFE) flag with engraved text „ARMED" and „SAFE". The loading/unloading procedure for the system is described in paragraph 3.3.3.6.
The SAFE-WHEEL has the following functions (see Figures 6 and 7):

- Interruption of electrical power path via an internal ignition path switch (interlock switch #1).

- SAFE/ARMED detection by the microprocessor using an internal monitoring switch (interlock switch #2).
- Mechanical interlock of the cartridge carrier in the ARMED-position.
- The „interlock switches“ will be activated by a disc cam mechanism on the shaft of the SAFE-WHEEL.

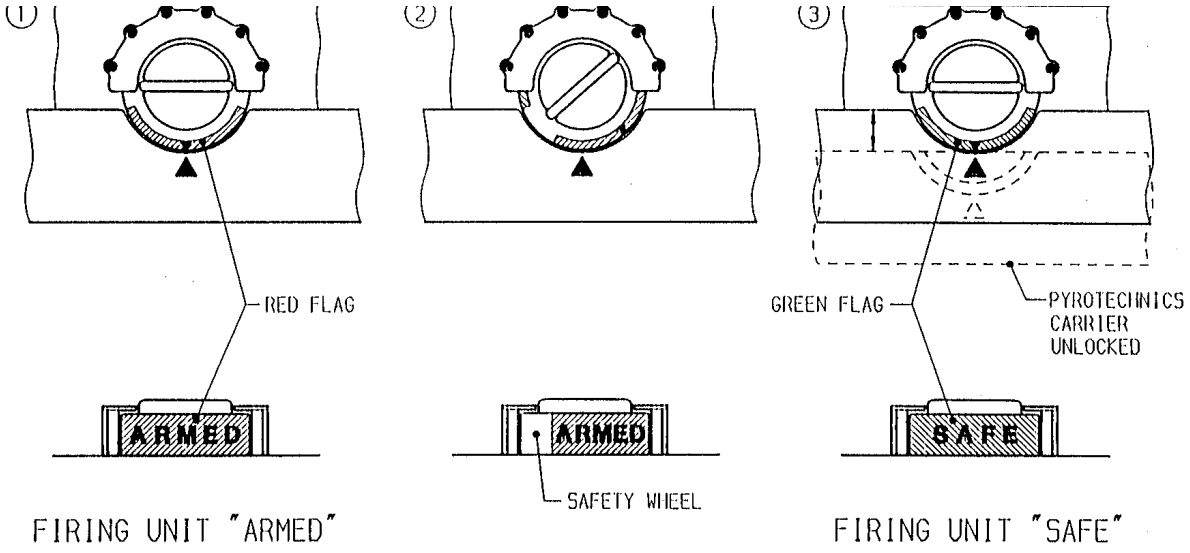

Figure 6: Side view on SAFE-WHEEL (Firing Unit)

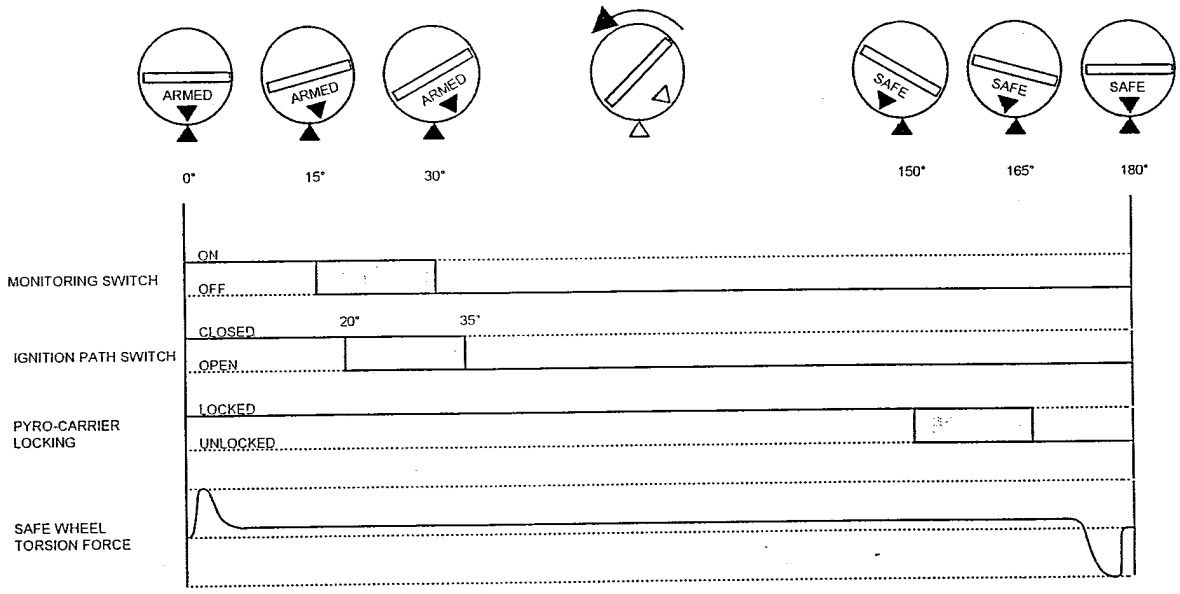

Figure 7: SAFE-WHEEL function diagram

3.2.1.3 Firing Sequence. The Firing Unit activates the pyrotechnics in a prescribed sequence from the first active loaded position to the last active loaded position. One pyrotechnic is activated with each valid trigger signal. The firing sequence stops when the last active loaded position has been fired and starts over at the first active loaded position after reloading. The priority of loaded positions starts at position 1 in Figure 5 and goes left to right, row by row to position 60.
Each valid trigger signal causes the MGSS to immediately activate (fire) one pyrotechnic cartridge. The Firing Unit is capable of producing the activation's every 3 +/- 1 seconds for the entire 60 positions. The trigger processing is shown in Figure 8. The ignition path is shown in Figure 9.

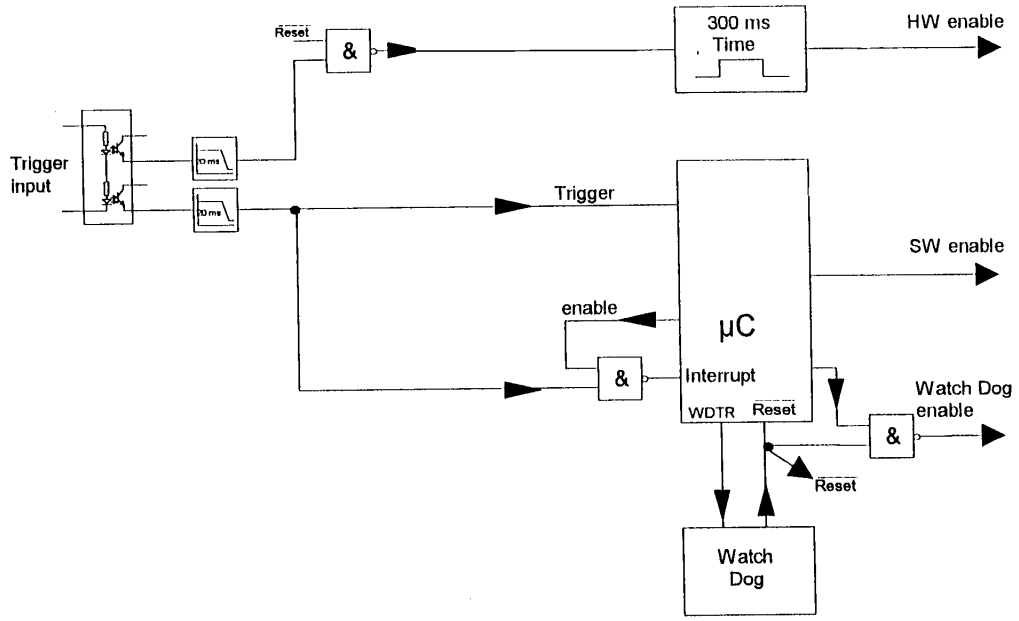

Figure 8: Trigger processing

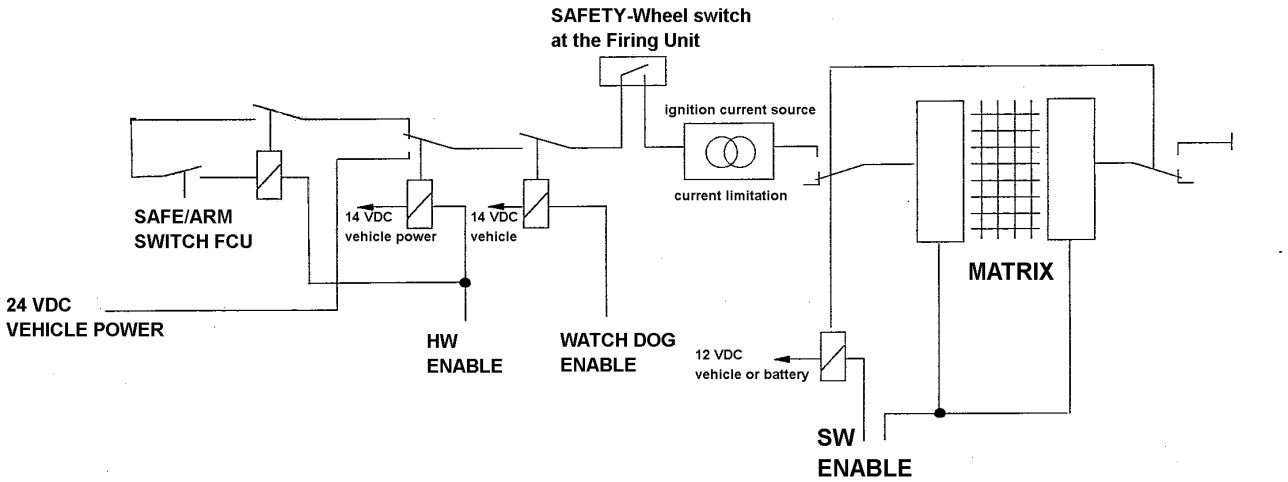

Figure 9: Ignition path

3.2.1.4 Firing System Reset. The MGSS resets to the first active loaded position each time the system is powered up (ARMED), or any time that the system is intentionally reset by cycling the SAFE/ARM-Switch of the Fire Control Unit from „ARMED'' to „SAFE'' and back to „ARMED''

3.2.1.5 Firing Capacity. The Firing Unit is capable to fire 60 consecutive pyrotechnics without reloading. Any number of pyrotechnic can be safely loaded from 1 to 60.

3.2.1.6 Operating Voltage. The MGSS will normally operate from vehicle power (external).

3.2.1.6.1 Vehicle Power Source. The MGSS is designed for an operating voltage (external) of 16 VDC to 32 VDC and has surge protection of up to 250 volt spikes. Circuit protection and losses are included in the 16 VDC minimum.

3.2.1.7 Power On/Off Condition. In the event MGSS power is lost or turned off, the Firing Device returns to the first detected active loaded firing location when the system power is restored and the system is reset.

3.2.1.8 Safety Interlock.

a. The SAFE-WHEEL of the Firing Unit provides both a mechanical safety interlock and two electrical interlocks.
b. The Firing Unit cannot be opened until the SAFE-WHEEL is turned into the SAFE position.
c. There are two electrical interlocks (switches), activated by turning the SAFE-WHEEL. One switch interrupts the ignition path, the other provides a signal for the microprocessor to „safe“ the system via software control.
d. If the Firing Unit is opened without setting the Fire Control Unit into SAFE position, the microprocessor maintains the „safe“ or disabled state. A reset of the FCU is necessary, see 3.2.1.4.

3.2.1.8.1 Loading/Unloading Interlock. The operator cannot open the Firing Unit to load the pyrotechnics unless the SAFE-WHEEL is turned to the SAFE-position. On the normal load/unload procedure the operator has to set the SAFE/ARM-Switch of the Fire Control Unit into SAFE-position and has to turn the SAFE-WHEEL on the Firing Unit into SAFE-position (approach FU from opposite side of the firing direction). Now the operator can open and load or unload the Firing Unit with pyrotechnics (see also paragraph 3.3.3.6).

3.2.1.8.2 Safety Interlock Status Indicators. The SAFE/ARM status of the system is indicated by the SAFE/ARM-Switch on the Fire Control Unit (see Figures 4) and the SAFE-WHEEL with red (engraved text „ARMED“) and green flag (engraved text „SAFE“), see 3.2.1.2.1.

3.2.1.9 Audio/Visual Cue. The MGSS uses a pyrotechnic to produce the audio/visual cue.

3.2.1.9.1 Flash. The MGSS provides a flash visible at a distance of 3000 meters, on a „Standard clear day“ as defined in the AMSTI-93-S026 paragraph 3.2.1.9.2.1. For testing purposes, a minimum value of 660,000 candela (peak) at 20m was established by ARDEC.

3.2.1.9.1.1 Thermal Imaging Optics Detection. The MGSS, when fired is visible by thermal imaging optics, on a „Standard clear day“ as defined in the AMSTI-93-S026 paragraph 3.2.1.9.1.1, at a distance of 3000 meters. The thermal imaging optics systems capable of viewing the pyrotechnic thermal signature are those systems installed on the TOW and Bradley (M2/M3).

3.2.1.9.2 Smoke. The MGSS produces a white smoke which is visible at a distance of 3000 meters on a „Standard clear day“ as defined in the AMSTI-93-S026 paragraph 3.2.1.9.2.

3.2.1.9.3 Bang. The noise generated by the MGSS is 130+15/-10 dB peak at a distance of 20 meters.

3.2.1.10 Pyrotechnic. The MGSS Audio/Visual Cue Pyrotechnic Simulator (AVCPS/MGSS) is in accordance with the requirements of 19200-DS-138 and the following requirements. See also paragraph 3.1.2.

3.2.1.10.1 Replacement of Pyrotechnic. The operator can load or unload pyrotechnics from the Firing Unit in three minutes or less with no tools.

3.2.1.10.2 Pyrotechnic Interchangeability. The AVCPS/MGSS is designed such that the DIFCUE Audio/Visual Cue Pyrotechnic Simulator and other similar pyrotechnics common to the training environment in which the MGSS is used, cannot be used in or activated by the MGSS.

3.2.1.10.3 Fragmentation. Outside a safety distance of 5m the MGSS, when firing an AVCPS, doesn’t discharge hazardous fragments or debris or generate sufficient heat/radiation that could ignite nearby foliage, damage nearby equipment or cause skin breakage, burns, or eye injury to personnel.

3.2.1.10.4 Pyrotechnic Interface. The pyrotechnic is manually installed into the MGSS by inserting the cylindrical cartridge into the loading holes of the Firing Unit. To activate the pyrotechnic cartridge, the DIFCUE provides a nominal 5A signal (7 A max.) to the cartridge`s electric match through two contact pins at the base of the cartridge.

3.2.1.11 Transit Case. A transit case is not part of the MGSS Kit as defined in this specification.

3.2.1.12 MGSS External Interface Requirements. The MGSS interfaces mechanically and electrically with the MILES 2000, the SAWE/MILES II-VDD and the vehicles.

3.2.1.12.1 Interface Description. The MGSS activates on a trigger signal from the MILES 2000 and the SAWE/MILES II-VDD. The MGSS is only activated by a signal of +5 volts to +31 volts for more than/or equal 80 milliseconds (see Figure 10). Transients and spikes are in accordance with the EMI Test Procedure for MILES 2000 MGSS/DIFCUE/AVCPS (Doc.No.: 9606502) paragraph 2.6. On the MGSS Firing Unit there is a trigger cable receptacle J1 according MS3114E8-4PW. All other

connectors or receptacles on the MGSS system are in accordance with VG95234. No trigger cable is provided with the kit defined herein - the trigger cable is provided at the next system level.
The system must sense the trigger signal drop-off to 4 VDC min before another trigger signal will be accepted.

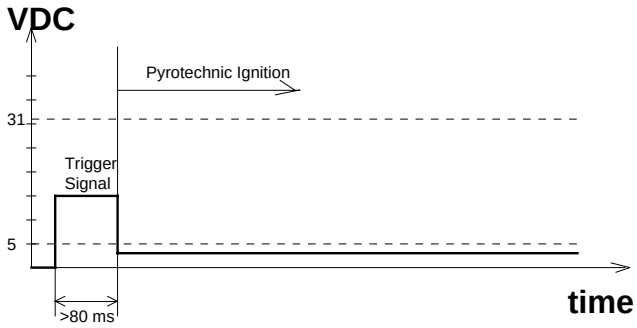

Figure 10: Timing diagram of a valid trigger signal

3.2.1.12.2 Vehicle Power Interface. The Fire Control Unit includes receptacle J1 in accordance with VG95234 B1-10SL-3P1N. A DC power cable is included in the kit to interface with the 24VDC vehicle power - see also the applicable installation instructions/manual.

3.2.1.12.3 Vehicle Interface Description. Special mounting adapters are required to install the MGSS Firing Unit on most vehicles. The Firing Unit has 4 captive screws, which provide mounting capability for adapters. The mounting adapters are not part of the MGSS Kit as defined in this specification. The Fire Control Unit is designed to be mounted inside the vehicle with a hook and loop (velcro) pad. The Firing Unit mounting hole pattern and the Fire Control Unit pad are shown on Interface Control Drawings 149106 and 149102 respectively.

3.2.2 Physical Characteristics. The following subparagraphs describe the minimum required physical characteristics of the MGSS.

3.2.2.1 Weight. The assemblies of the MGSS Kit have the following weights (Tolerance:+ 7.5%):

MGSS Firing Unit:	56.0 lbs
MGSS Cable Assy FCU/FU:	4.9 lbs (8meters length)
MGSS Fire Control Unit:	1.5 lbs
MGSS Cable Assy DC-Power:	0.9 lbs (5 meters length)
Miscellaneous:	0.7 lbs
nominal weight:	64.0 lbs (maximum)

3.2.2.2 Size. The assemblies of the MGSS Kit have the following sizes (the sizes given are in inches):

MGSS Firing Unit:	approx. 21.7“ x 15.8“ x 8.3“ [width x height x depth]

MGSS Cable Assy FCU/FU:	spooled up:	17.7“ in diameter, 2.0“ in height
MGSS Fire Control Unit:	approx. 5.3“ x 4.5“ x 2.5“ [width x height x depth]	
MGSS Cable Assy DC-Power:	spooled up:	7.9“ in diameter, 1.2“ in height

3.2.2.3 Finish And Color. All aluminum parts are chemical film treated in accordance with MIL-C-5541 Class 3 or equivalent.

Paint for exterior surfaces: Primer in accordance with MIL-P-85582 Type 1 Class 2 or equivalent;
Color Black: FED-STD-595 Color Number 37030
or
Powder Coated using „Tiger Drylac Series 19 No. 09/00241“ RAL 9005 Matt, Vendor, Tigerwerk, A-4600 Wels, Austria or equivalent.

Stainless Steel Parts without surface treatment: Anodic Oxidation in accordance with DIN 17611.

3.2.2.4 Circuit Card Assemblies. The circuit card assys shall be designed and fabricated in accordance with ANSI/IPC-D-275 and ANSI/IPC-RB-276.

3.2.2.4.1 Coating/Protection of Circuit Card Assemblies. The type of coating is in accordance with MIL-I-46058. The process of coating is in accordance with the regular process specification of the used coating.

3.2.3 Reliability. The MGSS Kit shall meet the required Mean Time Between Failure (MTBF) quantitative reliability requirement of 530 activation’s. Verification of Reliability requirement shall be done using MIL-HDBK-781 and the approved Reliability Test Procedure.

3.2.4 Maintainability. The maximum Mean Time to Repair (MTTR) shall be 15 minutes. This represents an operational level of maintenance where the major assemblies (Firing Unit and Fire Control Unit) can be disconnected, removed from their mounting, and replaced. Additionally, the MGSS shall be designed with easily replaceable subassemblies and shall have Built-in-test capabilities to diagnose failures.

3.2.5 Environmental Conditions. The MGSS shall meet the environmental requirements as specified in AMSTI-93-026.

3.2.6 Transportability. The MGSS Kit, in the transport case, shall withstand without damage, the stresses incidental to movement, handling in transit, and tie-down aboard common carrying vehicles such as aircraft and trucks.

3.2.7 Computational System Requirements

3.2.7.1 Operational Computer System. The operational computer system shall use one or more Commercial Off the Shelf (COTS) processors, components and connectors. The processor(s) shall have a word size, operating speed, installed memory, and bus bandwidth to fulfil the performance

requirements of this specification and have spare capacity. The following resources shall be provided as a minimum:
Spare memory = at least 50%.
Spare processing time = at least 50% of the highest averaged over a continuos operation period.
I/O capacity to accommodate all the required and designed-in functions.

3.2.7.2 Operational System Software. The operational system software shall consist of one or more of the following: developed software, reusable software, COTS software, and modified, previously developed software.
The software engineering methods are in accordance with AMSTI-93-S026 and RTCA/DO-178B. The program language is Assembler.

3.2.7.3 Firmware. Code and/or data which is stored in hardware devices (e.g., Programmable Read Only Memory) is considered software and shall be incorporated into the appropriate Computer Software Configuration Items (CSCI) with the same requirements as other software.

3.2.7.4 Built-in-Test (BIT). If the BIT recognizes a fault in the system, a error code is displayed on the 7-Segment-LED on the Fire Control Unit. The list of error codes is shown in paragraph 3.2.7.4.1.

The following BIT-Functions are incorporated into the system (see Software Design Document MILES 2000 MGSS/DIFCUE; Doc.No.: MGSS/DIFCUE-202-1.3; paragraph 4):

- SBIT: Self-test after power-on (ARM)
  SBIT controls the processing during start-up Built-in- Test. As long as the test is active all segments of the display and both LED's are switched on ('lamp test'). A set of test functions is activated sequentially. If any of those test functions indicates an error, the test sequence is aborted and the error is passed to the calling mode.
- IBIT: Initiated BIT by pressing the push-button > 1 second on the Fire Control Unit (see paragraph 3.2.1.1)
  IBIT controls the processing during initiated Built-in-Test. As long as this test is active all segments of the display and both GO and NO GO indicators are switched on ('lamp test'). A set of test functions is activated sequentially. If any of those test functions indicates an error, the test sequence is aborted and the error is passed to the calling mode. The test sequence is also aborted if a valid trigger pulse has been recognized.
- CBIT: Continuous BIT as permanent software function.
  CBIT controls the processing during continuous Built-in-Test. A set of test functions is activated sequentially. If any of those test functions indicates an error, the test sequence is aborted and the error number is passed to the calling mode. If a valid trigger pulse has been recognized, the test sequence is aborted.

3.2.7.4.1 Error Codes. If the NOGO-LED on the Fire Control Unit is continuos red, an error code is displayed. The error codes are listed in the following table:

Error Number	Meaning
01	**defect RAM memory of microcontroller**: read/write test failed for at least on memory cell, detected by SBIT/IBIT
02	**defect ROM memory**: microcontroller computed invalid checksum of ROM memory, detected by SBIT/IBIT
03	**defect timer system**: the microcontroller´s timer is not running, detected by SBIT/IBIT
04	**failure at serial I/O´s**: at least one of the shift registers that are used to control the matrix transistors has failed, detected by SBIT/IBIT
05	**failure of AD converter**: the microcontroller´s internal AD converter has delivered at least one invalid value at its internal channels (i.e. reference, ½ reference or ground couldn't be measured correctly) , detected by SBIT/IBIT
07	**failure of `watchdog relay`**: an unallowed high voltage has been detected at test point TP3 in the ignition path during SBIT/IBIT
08	**failure of `current source`**: an unallowed high voltage has been detected at test point TP4 in the ignition path during SBIT/IBIT
11	**failure of FCU supply**: FCU supply voltage too low, detected by SBIT/IBIT
12	**stack error**: RAM memory has been overwritten due to a stack overflow, malfunction of microcontroller, detected by CBIT
13	**failure of highside matrix FET**: detected a short circuit at one of the highside FETs which are used to switch on the selected matrix point for ignition, detected by SBIT/IBIT
14	**failure of lowside matrix FET**: detected a short circuit at on of the lowside FETs which are used to switch on the selected matrix point for ignition, detected by SBIT/IBIT
15	**Safe wheel open or not closed properly**, detected by SBIT/IBIT
24	**failure at serial I/O´s**: at least one of the shift registers that are used to control the matrix transistors has failed, detected by CBIT
27	**failure of ignition current**: no ignition current was measured during ignition (this could be a failure in the MGSS firing circuitry or it could be a failed pyrotechnic in which the match is abnormal) , detected by CBIT
F1	**pushbutton „TEST" depressed or defective** during start-up, detected by SBIT
F2	**static trigger present**: this **no failure of MGSS**, but indicates an incorrect trigger input interface. A static trigger level is sensed at the trigger input during start-up. To avoid the self generation of a trigger pulse (i.e. rising edge) when enabling the trigger input, the system is deactivated until the trigger level is low, detected by SBIT
F3	**pushbutton „FIRED ROUNDS" depressed or defective** during start-up, detected by SBIT

3.3 Design and Construction. The MGSS design and construction complies with the requirements stated in the following paragraphs.

3.3.1 Materials, processes and parts.

3.3.1.1 Hazardous Materials. The MGSS system without the Audio Visual Cue Pyrotechnic is free of hazardous material. The hazards from the Audio Visual Cue Pyrotechnic are limited by the 19200-DS-138 and specified in the military specification for the Audio Visual Cue Pyrotechnic. The MGSS shall not incorporate any asbestos or suspended glass fibre materials. The system shall preclude exposure of personnel or the environment to excessive levels of toxic, carcinogenic, or otherwise hazardous materials as defined by the Occupational Health and Safety Agency (OSHA), Environmental Protection Agency (EPA), or the Department of Transportation (DOT).

3.3.1.2 Castings. The casting material is aluminum.

3.3.2 Nameplate and Markings. The nameplates are mounted so that they may be seen and read easily. Assemblies, subassemblies and parts are marked in accordance with MIL-STD-130.

3.3.2.1 Main Identification Plate.

3.3.2.1.1 Fire Control Unit and Firing Unit: An aluminum plate with black background and natural text and text fields contains the nomenclature, contract-no., description, part-no., revision status, serial-no. and an application notice.

3.3.2.2 Warning and caution labels /markings.

3.3.2.2.1 Fire Control Unit and Firing Unit: The caution plate on FCU and FU, with black background and yellow text, has the following content: „CAUTION: THE SYSTEM MUST BE IN THE SAFE MODE BEFORE OPENING OR LOADING THE FIRING UNIT“

3.3.2.2.2 Hint Label on Firing Unit (visible after opening the cartridge carrier):
The hint label on FU, with black background and white text, has the following content: „USE ONLY M30 (MGSS) CARTRIDGES IN THIS DEVICE“.

3.3.3 System Safety. The MGSS provides fail-safe features for safety of personnel during installation, operation, maintenance, loading/unloading, and testing. The Operating and Support Hazard Analysis (O&SHA) for the keyless Main Gun Signature Simulator (MGSS), Direct / Indirect Fire Cue (MGSS) and the Audio Visual Cue Pyrotechnic Simulator (Doc.No.: 9721803) deals with the evaluation of hazards or risks and the control of hazards or risks. The O&SHA makes notes for operational and support procedures. For operational safety see also 3.2.1 herein.

3.3.3.1 Electrical Safety. The electrical circuitry complies with the requirements of the National Electrical Code and the Occupational Safety and Health Act. The equipment is adequately grounded to

protect equipment and personnel. The DIFCUE has a SAFE/ARM-Switch with a switch guard at the Fire Control Unit (see 3.2.1.1) and a SAFE-WHEEL on the Firing Unit (see 3.2.1.2.1). If the SAFE/ARM-Switch is pushed into SAFE-position, all power of the complete equipment is interrupted. If the Firing Unit was opened without setting the Fire Control Unit into SAFE-position, the microprocessor sets the FCU out of function. A reset of the Fire Control Unit is necessary (push SAFE/ARM-Switch from ARMED-position into SAFE-position and back into ARMED-position). A Built-in test function provides fault detection and failures of a ``GO“ (green indicator lamp on Fire Control Unit) or „NOGO“ (red indicator lamp on Fire Control Unit) nature. The maximum voltage in the device is 31 VDC, the maximum current is 7 A.

3.3.3.2 Personnel Safety. The safety distance for the MGSS in operation (firing pyrotechnics) is 20m for noise hazards and 5 m for health hazards. Outside of this area there will be no influence of heat flux or fragmentation to personnel.

3.3.3.3 Mechanical Safety. The MGSS is designed under consideration of personnel safety. The design incorporates handles on two opposite sides of the firing unit and a SAFE-WHEEL as a mechanical interlock (when the cartridge carrier is closed in the ARMED-position). The Firing Unit is configured to open or close in a clam shell manner. There are positive latching handles that lock the main body of the firing unit to the cartridge carrier portion of the firing unit. When the device is opened, after the SAFE-WHEEL is turned into SAFE-position, there is no contact of the pyro cartridges with the firing plate. Electrical contact occurs only when the two portions of the firing unit are positioned, locked and the SAFE-WHEEL is turned into ARMED-position. Proper procedures must be followed to assure that the device is „safe“ and that personnel avoid being in very close direct line of fire of loaded cartridges. Edges and corners be rounded and free from burrs.
When the cartridge carrier is loaded with pyrotechnics and the handles are not latched, turning the SAFE-WHEEL into ARMED-position is not possible.

3.3.3.4 Fail-Safe. The MGSS has a fail-safe shut-off which removes power from the MGSS when in safe mode and contains two separate status indicators, which indicate when the unit is armed and when in safe position (see 3.3.3.1). The MGSS is not capable of receiving or generating false or uncontrolled signals which would cause it to generate a pyrotechnic activation inadvertently.

3.3.3.5 Loading/Unloading Pyrotechnics. The pyrotechnics are designed to be safe for normal handling, transport and storage. Nevertheless, care should always be taken when working with pyrotechnic devices. The normal loading/unloading procedure is as follows:

a. The SAFE/ARM-Switch of the Fire Control Unit is pushed down into the SAFE-position (closing the red switch guard will force the switch to the SAFE-position). In the SAFE-position all power is switched off and there should be no system activity.
b. Approach the Firing Unit from a direction away from or to the side of the pyrotechnic firing direction.
c. Grip the SAFE-WHEEL of the Firing Unit and rotate into the SAFE-position (operator sees green portion of wheel with engraved text „SAFE“). Now the SAFE-WHEEL locking between the cartridge carrier and the main housing is released.

d. Release the two side latches by pulling up on the side handles, then clear the latches so the cartridge carrier can be swing open.
e. Load/unload with the proper pyrotechnic cartridges.
f. If loading is complete, close the cartridge carrier, position the two latches and press down on side handles until latches are fully secured. Then rotate SAFE-WHEEL to the ARMED-position.
Note: when the cartridge carrier is loaded with pyrotechnics and the latches are not fully secured, the SAFE-WHEEL cannot be engaged and cannot be rotated into the ARMED-position.
g. If unloading is complete (and reloading is not desired) then close the cartridge carrier, position the two latches and secure them. The SAFE-WHEEL can remain in the SAFE-position.
h. After loading the Firing Unit, and with the SAFE-WHEEL in ARMED-position, the SAFE/ARM-Switch at the Fire Control Unit should remain in the SAFE-position until the system is ready to be used.

3.3.3.6 Hangfire. There may be a situation in which the MGSS sends the appropriate activation signal and the pyrotechnic does not fire. The MGSS provides no indication of this type of pyrotechnic failure. As long as the electric match of the pyrotechnic is detected, the system recognizes this position as loaded position. There is no identification of hangfire pyrotechnics incorporated in the system. The MGSS moves on to the next available position when it receives the next trigger signal. Upon reset of the MGSS, BIT will run and the system may or may not produce an error code 27 depending on the integrity of the electric match inside the pyrotechnic. The suspect pyrotechnic should be removed and disposed of properly. The MGSS should be reloaded and checked via BIT.

3.3.4 Human Performance/Human Engineering. The MGSS permits rapid, error free performance of critical operational and maintenance tasks by 5th through 95th percentile soldiers working in the anticipated environments. The MGSS meets the criteria stated in MIL-STD-1472 (excluding paragraphs 5.7, 5.10, 5.11, 5.12, 5.14, and 5.15), MIL-STD-1474, MIL-HDBK-759, and the requirements of this specification.

3.3.5 Interchangeability. Items, subassemblies and parts with the same identification/part number shall be interchangeable in any MGSS device.

3.3.6 Workmanship. Workmanship shall be in accordance with MIL-STD-454 Rqt. 5 and 9.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection. The contractor is responsible for the performance of all inspection requirements as specified herein. The contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspection set forth in the Specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for Compliance. All components of the MGSS must meet all requirements of Sections 3 and 5. The inspection set forth in this Specification becomes a part of the Contractors overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Contractor Furnished Inspection Equipment.

4.1.2.1 Testing Facilities. Room conditions for test facilities are as specified in MIL-STD-810, Paragraph 5.1, subparagraph a., standard ambient.

4.1.2.2 Contractor Design. Concept, construction, materials, dimensions, and tolerances used in design of test equipment is selected and controlled to ensure that the test equipment indicates reliable acceptance of a product that does not exceed 90 percent of the prescribed tolerance limit and permit positive rejection when nonconforming.

4.1.2.3 Test Log. The log contains information by date as to those equipment activated, maintenance performed including adjustments and alignments, equipment failure, redesign, and replacement. The Contractor presents the information in the log to help the Government technical representative determine that the maintenance, alignment, or replacement has not invalidated previously completed tests.

4.2 Quality Conformance Inspections.

4.2.1 Acceptance Test. The MGSS should be tested in accordance with the „Acceptance Test Procedure for the MILES 2000 MGSS & DIFCUE“ Doc.No.: 9719201.

4.2.2 Conformance Verification. The results of the Acceptance Tests will be recorded in the Acceptance Test Report for Group A, B and C Inspection (see Acceptance Test Procedure for the MILES 2000 MGSS & MGSS“ Doc.No.: 9719201).

4.3 Pre-Production Qualification Test (PPQT). Prior to start of production and following any change in regular production methods, a production qualification lot of MGSS Kits shall be produced and tested in accordance with AMSTI-93-S026 paragraph 4.4.

4.4 Quality Conformance Inspections. Quality conformance inspection/tests shall be performed on all production lots in accordance with AMSTI-93-S026 paragraph 4.5.

5. PREPARATION FOR DELIVERY

5.1 Preservation, Packaging, Packing and Marking. Preservation, Packaging. Packing and Marking of the MGSS shall be in accordance with MIL-STD-2073-1, to assure arrival of each MGSS at its destination in an undamaged condition. Marking shall be in accordance with MIL-STD-129.

6. NOTES

6.1 Intended Use. The MGSS will be used to enhance the realism of training exercises. The MGSS is intended to simulate the flash, smoke, and noise of main gun fire of armor vehicles during training. The major role of the MGSS shall be to operate with the MILES 2000 in tactical (force-on-force) training exercises in accordance with Army Training and Evaluation Programs. The MGSS shall be capable of operating while mounted on vehicles that can be mobile or stationary. The MGSS will be deployed wherever the MILES 2000 is deployed.

6.2 Definitions

6.2.1 Damage. Damage is defined as the degradation in specified performance evidenced by one or any combination of the following conditions: breakage, loosening, shift, failure of any finish; failure of any hardware connection; failure of any component; condensation or moisture within the system packages; or deterioration in quality or complete failure of system performance as specified in this Specification.