

CONTRACTOR LIBRARY

Standard No. S24.807
June 29, 1988
(Revised 15Aug88)

MAN-MACHINE INTERFACE (MMI) STANDARDS

1.0 SCOPE

1.1 Purpose. This document presents a set of minimum man-machine interface (MMI) standards for the National Oceanic and Atmospheric Administration (NOAA), the National Environmental Satellite, Data, and Information Service (NESDIS).

1.2 Application. The requirements of this standard shall apply to equipment or systems developed or fabricated to Government specifications. Unless otherwise specified, they shall not apply to commercial production items (e.g. the 'Systems' console used in booting the system, running performance measuring software, running original equipment manufacturer (OEM) diagnostics, etc.), unless such items form an integral part of the equipment or systems developed or fabricated to Government specifications.

1.3 Contracting Officer's Technical Representative. The Contracting Officer's Technical Representative (COTR) shall provide the final interpretation of any conflict between this standard and specific contract requirements.

1.4 Waivers. Any request for waiver of specific requirements of this standard shall be submitted in writing to the COTR and to the Contracting Officer. A request for waiver must include: a) identification of the paragraphs for which the waiver is requested; b) identification of the systems, equipment, or components for which the waiver is requested; and c) a discussion of rationale for granting the waiver, including impact on reliability, maintainability, schedule, and cost if the waiver is not granted.

CONTRACTOR LIBRARY

2.0 APPLICABLE DOCUMENTS

NOAA/NESDIS Standard No. S24.802
"General Requirements for Ground Electronic Equipment"

NOAA standards are available from: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, OSD/3, Washington, D.C. 20233.

American National Standard Standard X3.64
"Additional Controls for Use with ANSII"

ANSI Standards are available from: American National Standards Institute, Inc., 1430 Broadway, New York City, New York 10018.

EIA Standard RS-170
"Electrical Performance Standards - Monochrome Television Studio Facilities"

EIA Standards are available from: Electronic Industries Association, 2001 Eye Street, N.W., Washington, D.C. 20006.

FIPS PUB 1-1
"Code for Information Interchange"

Federal Information Processing Standards Publications are available from: The Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

3.0 REQUIREMENTS

This section presents a set of minimum NOAA/NESDIS requirements, in the interest of fostering a more uniform and consistent approach in the design and implementation of man-machine interfaces and the selection of related hardware, thus simplifying the operational and maintenance training, and reducing the likelihood of operator errors.

3.1 PHYSICAL REQUIREMENTS

3.1.1 Screen Reauirements. The following requirements shall apply to the physical characteristics of the screen:

- a. The screen viewing area is to be not less than fifteen (15)

inches, measured diagonally. It shall use a raster scan refresh technology with a rate sufficient to ensure flicker-free display (minimum 60 Hertz non-interlaced).

b. All standard ASCII characters and symbols shall be generated using a resolution of not less than 7 x 9 pixels, in a cell not less than 8 x 10 pixels.

c. A screen shall be capable of displaying as a minimum, an 80-column by 25-row array of text. The 25th row may be dedicated to the console device status and need not be used by the applications unless specifically required. Screens displaying text shall be capable of reverse-video.

d. The contents of the screen must be readable by people, with 20/20 corrected vision, sitting or standing anywhere up to a distance of six (6) feet from, and within a 60-degree cone of, the terminal screen.

e. A screen shall be non-glare or be equipped with a commercial anti-glare overlay, cleanable with liquid and cloth (i.e. not requiring vacuum or compressed air cleaning).

f. A screen shall have integral adjustable viewing angles:
tilt (up and down) ; and, if not rack mounted, swivel
(side-to-side).

3.1.2 Graphics Reauirements. If the application calls for graphics capabilities, the screen shall provide a high resolution graphic capability consisting of an addressable matrix of at least 640 pixels x 350 lines for a single-page/screen display, and a 1024 pixels x 864 lines for multiple-page/screen display. The use of a graphic entry device is highly recommended.

3.1.3 Color Requirements. If the application has color requirements, at least 64 colors shall be available, with capability to display at least 16 colors simultaneously. In addition to colors, at least 8 distinct shades of gray shall be available for display. Full and half intensity outputs are not considered different colors.

3.1.4 Alohanumeric Keyboard Requirements. The following requirements shall apply to the physical characteristics of the keyboard:

a. Each operator terminal shall be equipped with a keyboard entry device capable of generating ASCII character sets as defined by FIPS PUB 1-1.

b. All keyboards shall be identical in layout, and shall correspond, with the concurrence of the COTR, to the format in

current use at the SOCC and CDA (Figure 1).

FIGURE 1

KEYBOARD LAYOUT

4

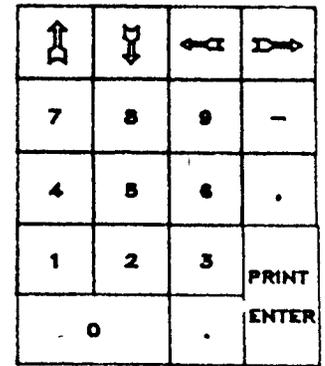
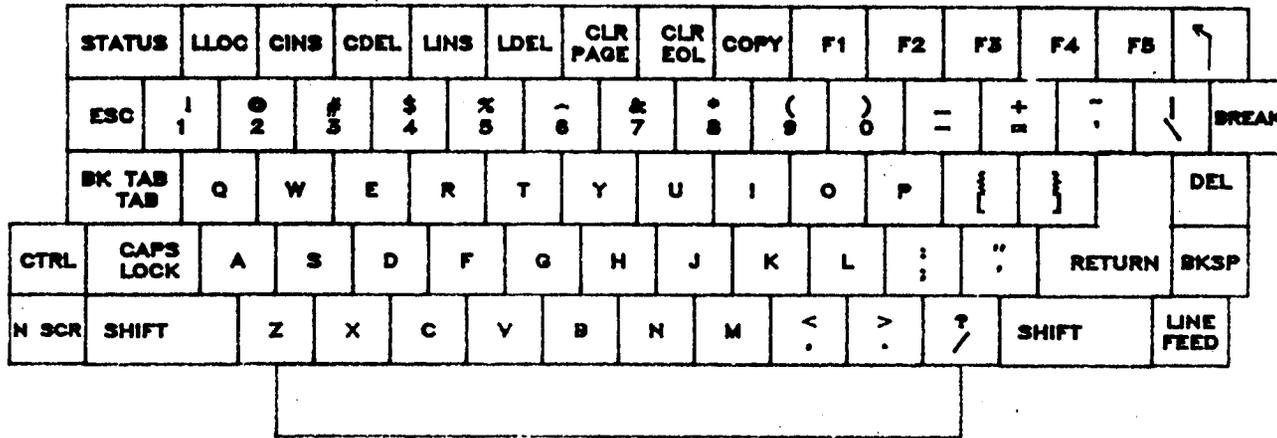


FIGURE 1. KEYBOARD LAYOUT

c. Each keyboard shall have a numeric keypad to the right of the standard (QWERTY) keyboard.

d. Each keyboard shall provide a minimum of fifteen (15) programmable function keys. The numeric keypad may be optionally used for function keys, but not visa-versa.

e. Each keyboard shall be attached by a coiled cable to permit movement on a desktop work area, and easy detachment.

f. Keyboards shall be capable of being temporarily stored while still connected, in order to allow full use of desktop space by the operator. (Note: This is not an implied requirement for furniture functionality.)

g. Keyboard keys used for special functions shall be permanently labeled if dedicated to a function, or provided with overlays, templates, or on-screen prompts if used for multiple functions.

3.1.5 CRT Interface Standards. The CRT terminal(s) shall be compatible with the ANSI X3.64 standard.

3.1.6 Text Hard Copy Reuirements. A hard copy printer, if called for by the application, shall be compatible with at least an RS-232 or Centronix parallel interface, and shall be capable of printing at least 150 characters per second (cps) or 2 pages per minute. It shall be capable of printing directly from the system and from the CRT screen (e.g. a "screen dump"). It shall have the complete 96-character ASCII font and shall require no special (e.g. thermal, silvered, or pressure sensitive) paper. Printers having a noise level exceeding 60 decibels (dbA) anywhere within 3 feet of the unit shall be provided with acoustical enclosures, unless identified in the system specification as being normally operated in unoccupied areas.

3.1.7 Svstems Printer Requirements. A system line printer, if required by the application, shall be capable of printing 132 columns of ASCII character information on ordinary fanfold paper up to 14-7/8 x 11 inches and must sustain a rate of at least 600 lines per minute (lpm). It shall support the full 96-character ASCII set (upper and lower case). System printers shall be provided with paper catchers.

3.1.8 Composite Video Reaquirements. A composite video output shall be provided for each CRT, to allow remote monitoring, compliant with EIA Standard RS-170. In color applications implemented with RGB output, it is understood the resolution requirements of Section 3.1.1 may not be met by the composite video output.

3.1.9 Miscellaneous Hardware Requirements. The following are miscellaneous hardware requirements:

a. Keyboards shall be replaced before delivery, if used in development efforts exceeding 6-months.

b. CRT units shall be replaced before delivery, if they show any sign of "burnout" as judged by the COTR.

3.2 OPERATIONAL REQUIREMENTS.

3.2.1 Operational CRT Page Format. CRT pages, designated by the COTR as 'operational' pages, shall follow the following standard format (see Figure 2):

a. The top line of the page shall be reserved as the system title / status area, to display the system ID(s), time(s), current mode(s) of operation, critical status summary information, etc.

b. The next line shall be reserved for operator key-ins (i.e., the command input line).

c. Immediately following the operator key-in line shall be the prompt/response line(s), used to prompt the operator for additional inputs, to display command completion status or to provide help information.

d. The three (3) bottom lines, lines 23-25, shall be reserved to display the most recent events (e.g., errors, alarms, etc). This area shall be scrolled automatically whenever new events are to be displayed, bottom-to-top (i.e., new entries shall appear at the bottom of the event display area, while the oldest entries disappear off the top).

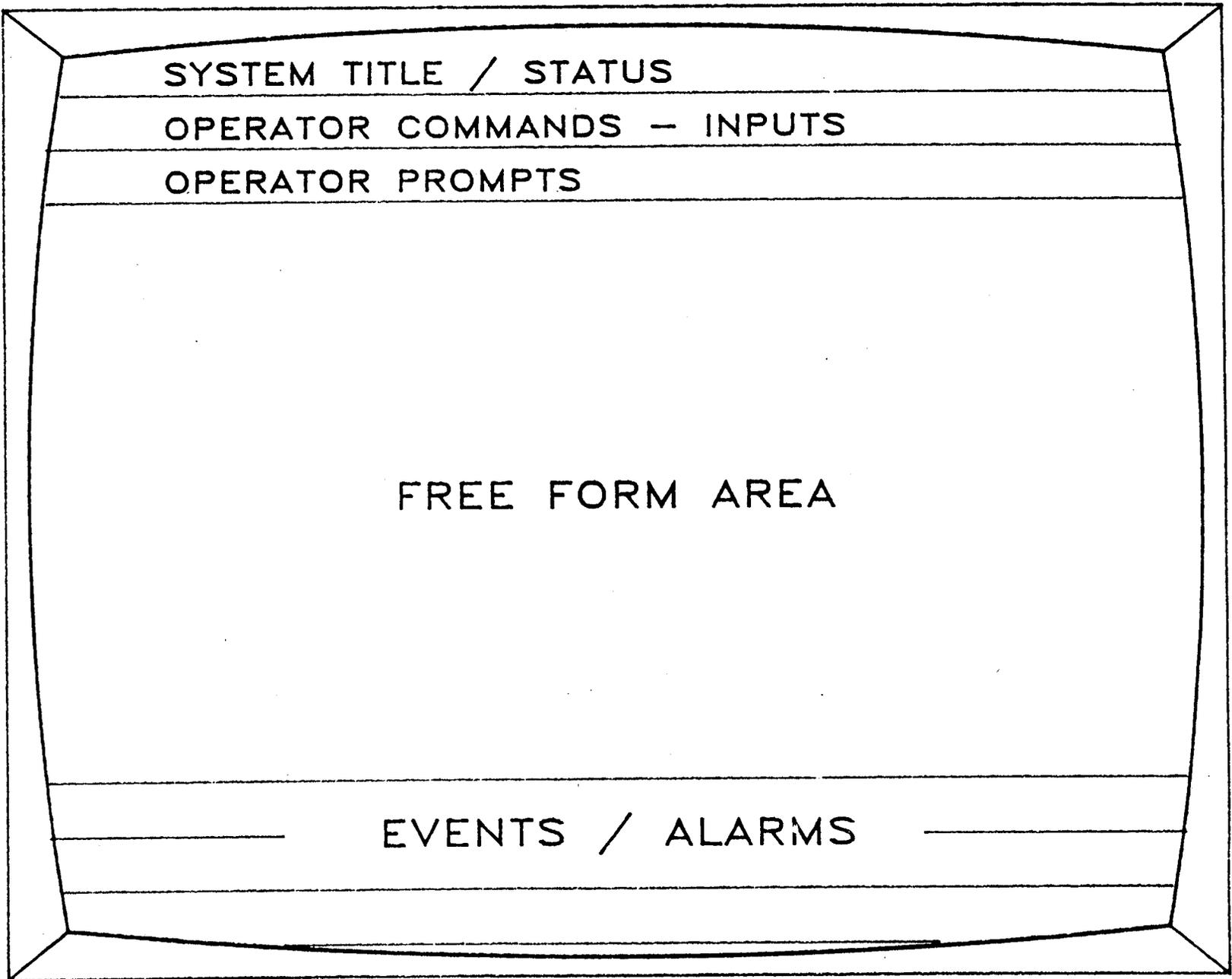
e. The format for the remainder of the page shall be defined by the application.

f. Non-operational CRT pages (e.g. pages for off-line diagnostic and special functions, or graphics) may use the entire screen unrestricted.

g. Nothing in this standard precludes the use of multiple page displays on a single CRT screen as long as the readability requirements of Section 3.1.1 are satisfied.

3.2.2 Operator Input Requirements. The following requirements shall apply to all operator inputs:

GENERAL OPERATIONAL CRT PAGE / SCREEN FORMAT



GENERAL OPERATIONAL CRT PAGE / SCREEN FORMAT

FIGURE 2

FIGURE 2. GENERAL SCREEN FORMAT

a. All operator inputs from a keyboard (including operator commands, command editing keys and special function keys) shall give the user a positive and immediate acknowledgment of the action (e.g. a tactile feel). The system shall report completion or abnormal termination of initiated functions and tasks, and provide audio and visual alerts.

b. All operator commands shall be echoed on the command input line of the CRT page as they are being keyed-in.

c. A positive/negative response shall appear on the command prompt/response line of the CRT page, after striking the RETURN key and when the command processing is complete.

d. No keyboard input shall ever be inhibited (e.g. as a result of internal processing, print functions, etc.).

e. The keyboard echo shall appear on the screen within 0.2 seconds of the keystroke.

f. CRT terminals shall be operated in full-duplex mode at all times, (i.e., the echoing of keyboard inputs shall not interfere with the refresh of a dynamic display, and vice versa (e.g., no locking)).

3.2.2.1 Operator Commands.

The following requirements apply to systems with command-line oriented inputs:

a. Operator commands shall consist of a unique keyword, followed optionally by a number of positional and/or keyword arguments, separated by blanks (or other suitable delimiter), limited to one 80-character line including the user prompt characters. Operator commands shall be input in a single case - upper or lower, and shall not require in-line (dynamic) use of the shift key.

b. Consistent, descriptive and easy-to-remember naming conventions shall be used for both commands and arguments.

c. Abbreviations shall be allowed where practical, provided there is no ambiguity.

d. All subsystems in a system shall use a common operator command structure. Mnemonics and format for similar functions shall be common to all subsystems.

e. Numbering sequences shall begin with "1," not "0."

The operator commands described in Table 1 represent command-line mnemonics and format in current use, and with which commonality is desired. Preference shall be given to the incorporation of these commands, as applicable, in the system design.

The system shall have the capability to execute operator directives from a disk-resident ASCII command file (macro) from each user position (keyboard). The command file inputs shall have the same format as the corresponding directives from the keyboard, except for optional time-tags, and in-line comments.

TABLE 1

Operator Command-line Command Commonality

ALMXXX	- To enable OR disable individual/global alarms.
BIASXXX	- Adds or subtracts time for time-tagged schedules or procedures.
BYE	- Initiates a controlled method of terminating software execution.
CMDCLR	- Clears and reinitialize command process.
CMDMODE	- Defines method of scheduled or manual command execution.
CMDXXXX	- Enables execution of various S/C command formats.
CONFIGXXX	- Configures ground equipment for operations.
CPUIDXX	- Defines which CPU is connected to operational software and peripherals.
CVOFF	- Disables CV.
CVON	- Enables verification of cmd loaded to S/C decoder.
DATAPATHXXX	- Defines various paths for data ingest and process.
DCDRXX	- Decoder address - XX = Decoder ID.
DPSSXX	- Configures DPSS for ingest of data clock and status information.
DQSRXXX	- Collect and print a report of data quality information.
DUMP	- Transfers files from disk to tape.
DUMPCMPR	- Compares ground load files with returned S/C load files.

ENABLEXXXXX - Calls a schedule or procedure for execution.

EVOFF - Disables EV.

EVON Enables verification of command executed by S/C.

FIXCRTXX - Clears and reinitializes CRT.

FRSYNXXXX - Enables configuration of frame synchronizers for various data rates, types, and sources.

GRAPHCOPY - Produce hard copy of graphic pages.

GRAPHXXX - Enables the graphic display of selectable TLM parameters.

GVOFF - Disables GV.

GVON Enables ground or probe verify.

KILL Terminates execution of a schedule or procedure.

LIMITSXXXX - Enable/disables global or individual parameter limit checking.

LINKXXXX - Network Switching MMI Commands..

LOAD - Transfers files from tape to disk.

LOGXXX - To enable or disable logging of individual/global events.

MASTERCRT - Allows a designated work station to control schedule or S/C command execution.

NBPORTXX - Determine which CPU port is fed by narrow-band input.

PAGEXXX - Displays a selected alphanumeric page on a specified CRT at a selectable update rate.

PAUSE - Temporarily stops execution of a schedule or procedure.

PLAYBACKXXXX - Allows TLM history file retrieval for display and archive product generation.

PRINTTLMXXX - Prints selected TLM parameters at selectable rates at local or line printer.

PROCEED - Used to exit from a "Pause".

RAWDUMP - Obtain print of raw TLM data

REQFIL - Request files from and there subsystem.

- SCID - **S/C I D**
- SHOWXXX - Enables a one line CRT display of any specified individual file parameters.
- SNAPXXX - Produces a print of any alphanumeric page defined in data base or displayed on CRT.
- SNDFIL - Tranfers files from one subsystem to another.
- SOCNAGE - Allows history files to be transferred from SOCC to remote sites.
- STRIPXXX - Enables stripcharting of specified parameters with selectable updates, scale factors, etc.
- TVOFF - Disables TV.
- TVON - Enables verification of commanded subsystem reponse.
- UP - Starts or restarts operations applications software.
- UPDATE - (In place of "Recover") updates individual subsystems with current status tables.
- WAITXXX - Pauses execution of a schedule or procedure for a specified amount of time.

For applications such as help functions, diagnostic programs, special purpose test simulators, etc., a menu-driven approach shall be acceptable as an alternative to the line-oriented command inputs. The following requirements shall apply to menu driven systems:

f. Inputs shall be entered from the keyboard, in response to program prompts. A track-ball or mouse shall be acceptable as alternatives for selection menu options. The track-ball is preferred in order to minimize operator space requirements.

g. Whenever multiple options are present, the program shall present a menu of the acceptable responses and range/limits of 'legal' values. Menus may be nested when necessary (i.e., hierarchical menus).

h. The operator shall be able to terminate/escape the program immediately from any menu.

i. If a binary choice is to be made in a menu, Y/N (Yes/No) shall be the only responses allowed (i.e., True/false, T/F, 1/0 responses shall not be accepted).

Numbering sequences shall begin with "1," not "0."

j. There shall be an option to use the default or to retain the previous value (e.g., RETURN key).

The following requirements shall apply to both command-line and menu-driven types of inputs:

k. There shall be prompts for any erroneous inputs, or for missing arguments which are mandatory. Invalid responses shall cause reprompts including an option to 'escape,' and not cause the program to terminate or abort, except for system security reasons (e.g., during a password validation);

l. A help capability shall be provided to assist the operator during command input. A special help / prompt key shall be defined (e.g., "?") to help the operator select the next command or argument or menu option.

3.2.2.2 Operator Special Keys. The following requirements shall apply to the special keys used for command inputs:

a. Special keys shall be reserved for purposes of editing the command inputs and terminating the current command. Since the labelling of the keys varies for each terminal, the following is only a suggested list:

- BACKSPACE to delete the last character;
- DELETE to delete the entire command line;
- RETURN to submit the command for execution;
- ESC to abort the last command still in progress;
- SCROLL to stop and resume scrolling of CRT outputs.

b. Programmable function keys shall be used to enter, either in full or in part, frequently used operator commands.

3.2.3 General Display Requirements. The following requirements shall apply to the non-graphics display functions:

a. The display functions shall not interfere with the operator input capability, or impact system performance adversely.

b. All static text/label content of a display shall be refreshed at a rate consistent with flicker-free operation. Dynamic text/label content of a display and all data on a display shall be refreshed at a user selected update interval. Dynamic text/labels and data shall be available for display within 0.5 seconds of their generation within the host (e.g. non-workstation) system.

c. The event message area shall be updated independently of the rest of the screen, as soon as new events are posted, at the

minimum rate of two (2) events (lines) per second.

d. The keyboard echo shall appear on the screen within 0.2 seconds of the keystroke.

The application-specific display area shall be reserved for display pages. These pages may be dynamic (refreshed periodically), or static (one-shot) in nature. The following requirements shall apply to the application-specific displays:

e. The system shall have the capability to define and store up to 200 CRT pages. These pages may be created off-line via an editor or utility program, with options to define the field labels, format (decimal, ASCII, hex, octal), attributes (e.g., color, brightness), position (row, column), etc. The fields may be arranged in a fixed format (e.g., columnar), or may be free formatted.

f. Any CRT page shall be selectable from any console. The capability to display pages remotely shall be an application-specific requirement.

g. A new page, **complete** with data, shall be displayed within three (3) seconds of its selection by the user, provided all the information to be displayed is already available in memory.

h. A dynamic screen shall be refreshed at a user selected frequency, consistent with the application requirements, at least once every ten (10) seconds. The fastest page refresh rate shall be two (2) times per second. The maximum number of simultaneously refreshed pages shall be an application-specific requirement. The refresh shall be concurrent with keyboard entry and directive execution. Options to stop/resume the refresh and / or clear the screen are highly recommended.

i. One-shot displays (e.g. non-dynamic, 'snaps') shall have a bi-directional scroll feature if more than one page long. The operator shall be able to suspend and resume scrolling with a single keystroke. The operator shall be able to abort a scrolling display.

j. The display contents (text labels and value fields) shall have a consistent, easy-to-understand format. When practical, user meaningful engineering values or plain English shall be used (e.g., ON/OFF, YES/NO), in lieu of raw, binary (e.g., '1'/'0'), hexadecimal or octal numbers. Local terminology and format conventions shall be observed (e.g., Julian day instead of month/day).

k. Different brightness levels, color, blinking fields and/or the inverse video features shall be used to improve the visibility of the various display fields. In particular:

- Low Brightness shall be used for titles, labels;
- High Brightness shall be used for refreshed values;
- Inverse Video shall be used to signal alarms;
- Change of Color shall be used to signal out-of-limits.

3.2.4 Graphics and Image Processing Requirements. The graphics and image processing requirements shall be defined individually for each application.

a) Application-specific graphics definitions will include requirements for point and line plots, bar and pie charts, color selections, axis definitions including range and annotation, conversion coefficients, update rate, and automatic and manual scaling.

b) Application-specific image processing definitions will include requirements for display resolution, gray scales and colors, display overlays, imagery zoom (in/out), panning, and scrolling.

3.2.5 Hard-copy Output Requirements. Most hard copy outputs will be application specific. They shall not however interfere with the display refresh or keyboard input functions. Printing shall not affect the real-time performance of the system. If there is a requirement to generate real-time output to a hard-copy terminal or line printer (e.g., real-time alarms), the operator shall have the capability to suspend, resume or abort such output.

The status of all printers (e.g.: on-line/off-line; error conditions; and paper out) usable by an operator shall be made available at the operator's console either on a dedicated display or integrated into the event/alarm monitoring function.

3.2.6 Event/Alarm Monitoring Requirements. The following requirements shall apply to event/alarm monitoring functions:

a. All events shall be logged chronologically, with an appropriate time-tag.

b. The type of events recorded shall be application specific. However, it shall include at least the following:

- All errors detected by the application software (hardware, I/O, communications) and system software;
- All system status or configuration changes;
- Operator directives;
- Inputs from other systems.

c. The text of the event/alarm message shall be concise and descriptive (i.e., self-explanatory). Text format and structure shall be consistent within a system. It shall include the following information:

- The message time (DDD/HH/MM/SS);
- The message ID (message number);
- Text of message;
 - Reference to system operations (e.g. a S/C telemetry value);
- Message type (optional);
 - Message source (S/C, System, subsystem, module ID) (optional).

The reference to system operations shall be an operator selectable field, assignable by message source, **chosen** from data known to the system.

d. The most recent three (3) event/alarm messages shall be displayed on the CRT, as they occur in real-time (see Section 3.2.1). Special colors, highlighting, blinking, inverse video, and audible alarms shall be used to alert the operator whenever an alarm condition is present which requires intervention/acknowledgment.

e. Alarm messages, a subset of event messages, shall be operator definable and **changable** from the total catalog of event messages by message ID.

f. Event/alarm messages shall be maskable, individually and by type or source, by the operator, using the message ID or message type or source identifier, independently for disk storage **(logging)**, display, printing, and alarming. The operator shall be able to enable/disable the printing and display functions globally. Audible alarms shall be enabled/disabled at each console. Operator directives shall not be **maskable** under any condition.

g. The system shall automatically mask and un-mask, under software control, individually and by message type, event/alarm messages after exceeding a database defined frequency for occurrence/absence of a particular message, and shall generate its own event message for the mask activation/deactivation. The database defining message frequency tolerances shall be operator modifiable in real-time.

h. The operator shall have the capability to selectively display and print the entire contents of the event log or portions thereof by time, message ID, message type, message source, or S/C, in chronological order, in the application area of the CRT page. The operator shall also be able to get a hard-copy of the same.

i. The log **review** (display/print) functions shall not interfere with the actual logging function (i.e., temporary locking at record/page level is acceptable; file level locking is not).

j. The size of the storage area set aside for event/alarm messages shall be dependent on the application. So shall be the storage medium selection: volatile (memory) versus non-volatile (disk). Typically space shall be provided for a minimum of 36-hours

of worst-case message logging, assuming automated masking is operational. Whenever the log space is exhausted, the oldest messages shall be deleted and over-written

The following event/alarm monitoring features are recommended:

k. The capability to display/print the contents of the event log selectively, by time, by message ID, spacecraft (S/C), type, or source.

l. The capability to send event/alarm messages to a hard-copy terminal or line printer, in real-time (i.e., as they occur); the capability to enable/disable such prints.

m. Making event/alarm information database resident, for online / offline retrieval, including text, message ID, type, source, mask flags, etc.

3.2.7 Miscellaneous Operational Requirements. The following are miscellaneous operational requirements:

a. The system shall include a system performance monitoring capability, to measure and report system and task (process) performances, including CPU, memory and disk utilizations.

b. The system shall include a screen editor for off-line text file manipulation.

c. The system shall include, to the extent allowed by the operating system, the capability to execute system level commands (e.g., CLI, DCL, TSM) from any console, concurrently with the application, to perform the following functions:

- Display / print files;
- Perform file / directory management functions (create, save, restore, delete, list, etc.);
 - Send / receive electronic mail (optional).

d. When required by the specific application specification, security shall be provided with the following features/characteristics:

- operator log-on and log-off (access) by password;
- functional access restrictions (e.g. view, operate, edit/change) by password (user)
 - maintain operator log-on statistics, and display connected consoles/users to an operator
 - restrict remote terminals from the 'on-line' system.