**STATE OF NEW JERSEY
DEPARTMENT OF TRANSPORTATION
TRENTON, NEW JERSEY 08625**

METRIC SPECIFICATIONS FOR VME BUS COMPUTER
(FIELD TERMINAL VME BUS PROCESSOR ASSEMBLY)

N.J. Specification No. EBM-FTERM-VME   Effective Date: July 1, 2001

New Jersey Department of Transportation Specifications for an open architecture VME Bus based field terminal processor assembly.

The purpose of these specifications is to describe minimum acceptable design and operating requirements for this equipment.

GENERAL - I

1-1   Components

The field terminal processor shall consist of the following components:

A.   Single Board VME Bus Single Board Computer with two (2) RS232 ports with OS-9 Target Software License

B.   Sixteen (16) additional independent RS232 Ports expandable to twenty-four (24)

C.   483 millimeter Rack Mounted 3U Half-Height VME Bus with nine (9) VME Slots minimum and AC power supply

D.   OS-9 Development Kit

E.   Field Control and Display Monitor

1-2   Environment

All VME Bus components shall be configured for extended temperature operation and shall be specified for operation in the temperature range of -40 °C to +85 °C and a relative humidity of 0 to 95 percent non-condensing. The equipment must be designed to operate inside a NEMA 3R outdoor enclosure. The manufacturer must supply certification by an independent technical laboratory confirming that the equipment complies with these environmental specifications.

1-3   Electrical Power

The VME Bus chassis defined in this specification shall operate on standard 120 volts AC electrical service. All other hardware components shall mount in the VME chassis and shall be powered from it. The equipment shall operate over a voltage range of 105 to 125 volts AC at 60 hertz.

1-4   Incidentals

All necessary interconnection cables, terminators, and other components necessary to provide a fully operational system shall be provided incidentally with the associated component.

1-5   Application Software

The application software for this processor shall be developed by others.

1-6   Diagnostic Software

The assembly shall be supplied with diagnostic software loaded on the processor board. This software shall provide a facility which will allow data received on the master port on the processor board to be sent to all of the off-board RS232 ports concurrently. In addition, data received on any of the off-board ports shall be transmitted to the master port.

All standard manufacturer diagnostic programs for all VME Bus components shall be supplied. In addition, a monitor/debugger shall be supplied which can be utilized to verify proper operation of all components.

SINGLE BOARD VME BUS SINGLE BOARD COMPUTER - II

2-1   Processor

The processor shall be a Motorola 68020 running at a clock speed of at least 16.0 megahertz. As an alternative, a code compatible processor of equal or greater speed can be provided.

2-2   Memory

A.   RAM- 1 megabyte (bytes) of Static RAM

B.   EPROM-1 megabyte (bytes)

C.   EEPROM-16 kilobytes (bytes)

2-3   Real Time Clock

A.   Month, Day, Year, Hour, Minute, Second, and Day of Week with SRAM and 12/24 hour options. Clock shall be setable via internal software commands. Clock shall have lithium battery backup rated for at least three years.

B.   Programmable alarm and periodic interrupts suitable for clock tasks.

C.   At least one 16-bit resolution timer/counters with interrupt capability above that required by OS-9.

2-4   Master/Slave Capability

2-5   Reset and Watchdog Timer Circuitry

2-6   Processor Board Shall Require 1 3U VME Slot

2-7   RS232 Ports

A.   Processor Board shall include two (2) RS232 ports configured for DTE operation and terminated on the face-plate with DB-15 Female Connectors.

B.   Baud Rates from 50 baud to 38.4 kilobaud shall be supported.

2-8   Board Support Package

A full feature board support package include complete software/firmware support shall be provided. This package shall interface with OS-9 and shall operate via one of the RS232 ports described in Section II-7

2-9   OS-9 Industrial License

The board shall be certified for use with OS-9 and shall be supplied with an unrestricted industrial license for the target system.

SIXTEEN (16) RS232 PORTS - III

3-1   Slots

A total of 16 RS232 ports, in addition to those provided with the CPU board, shall be supplied. No more than four (4) 3U VME slots shall be required for these components. Each port shall be terminated on a DB-9 or DB-15 connector mounted on the board faceplates or terminated on an external convenience panel.

3-2   Signals
The RS232 ports shall support Transmit, Receive, Logic Ground, Request to Send, and Clear to Send signals as a minimum.

3-3   Baud Rates

The ports shall support 300, 1 200, 2 400, 4 800, 9 600, and 19 200 baud rates, as a minimum. The signals shall be opto-isolated. If the baud rates are set in hardware, the board shall be configured for 2 400 baud operation.

3-4   Expandability

The system shall have the capability of being expanded to support an additional eight (8) RS232 ports.

3-5   Interrupts

At least one independent interrupt vector shall be supplied for every two RS232 ports. Interrupts shall be triggered upon transmitter empty, receiver full, and CTS transition. The receiver holding register shall be at least dual-buffered.

483 MILLIMETER RACK MOUNTED 3U HALF-HEIGHT VME BUS CHASSIS - IV

4-1   Slots

The VME Chassis must be fully certified to meet the requirements of IEEE 1014-87 version of the VME Bus specifications and contain a minimum of 9 fully Active Slots. The half-height form factor 3U shall be utilized.

4-2   Mechanical

The rack shall be configured for mounting in a standard 483 millimeter electronics chassis and shall be supplied with all necessary mounting hardware. The rack shall require no more than 178 millimeters of rack space.

4-3   Power Supply

The rack shall be supplied with a minimum of a 50 watt power supply. However, the supply must have at least 50% spare capacity over that required to power the CPU and RS232 boards specified in Sections III and IV. The chassis power supply shall include a standard AC line plug of at least 2.5 meters in length. The power supply shall include a mechanism to generate AC line frequency pulses suitable for generation of an interrupt via a digital input to the CPU board. This line frequency interrupt channel shall be fully wired and configured.

4-4   Face Plates

The rack must be supplied fully assembled with all required boards installed and tested. Blank face plates shall be provided for slots not utilized in the configuration.

4-5   Incidentals

The rack shall be supplied with all required connectors, terminators, and hardware required to yield a fully operational configuration.

OS-9 DEVELOPMENT KIT - V

5-1   Number Required

A complete development kit shall be supplied with every six (6) or fraction of VME bus assemblies delivered.

5-2   Kit Components

A.   OS-9 Professional with Drivers for all Ports and Adapters

B.   ANSI C Compiler and Assembler

C.   Complete MSDOS PC Cross Development Package and Monitor Source Code Control Package

D.   Microware M Shell

E.   All Motorola Processor's Manuals associated with the 68020 processor and support chips

F.   OS-9 Driver to support Block I/O to all RS232 port channels

5-3   Kit shall be supplied complete with all manuals, disks, user license for one station, and chassis cabling.

FIELD CONTROL AND DISPLAY MONITOR - VI

6-1   The Field Control and Display Monitor shall be an MSDOS notebook computer meeting the following specifications:

A.   Intel 80386 - 30 megahertz Processor or Faster

B.   4 megabytes of Memory, minimum

C.   60 megabytes or larger Hard Disk

D.   1.44 megabyte 90 millimeter Floppy Disk Drive

E.   2 RS232 Ports/1 Parallel

F.   Clock/Calendar
G.   VGA Backlit - Monochrome Display

H.   Maximum Weight - 3.2 kilograms

I.   Internal or External Pocket Hayes Compatible 2400 baud Modem

J.   Supplied with MSDOS 6.0 and Microsoft Windows 3.1

K.   Padded Carrying Case Custom Designed for Notebook

L.   Portable Microsoft Compatible Mouse

M.   Parallel Printer Cable

N.   Laplink Compatible File Transfer Software with Cable

O.   The computer shall be manufactured by IBM, Gateway or Compaq.

6-2   One field control and display monitor shall be supplied with every four (4), or fraction thereof, VME Bus assemblies. Half of the units shall be for Office of ITS Engineering support use.

6-3   Monitor shall be designed with 3 meters minimum RS232 adapter cable for connection to VME Bus RS232 monitor port.

TESTING - VII

All equipment defined in this specification shall be subject to factory testing as subsequently described. The factory test shall demonstrate or provide confirmation that all of the equipment operates over the specified environmental range for each component and meets the overall specifications. The factory test shall include at least one fully configured VME computer. A Field Control and Display notebook computer shall be connected to the VME bus computer over the monitor port. Via the monitor, the factory procedure shall verify that all subsystems are operational and addressable. Data shall be written to each RS232 port. This data shall be received by a terminal capable of displaying what was received for review. The procedure shall also demonstrate the use of the OS-9 development kit, including the burning of an operational EPROM.

The supplier shall be responsible for submitting a test plan which has been designed to exercise and monitor the equipment for the purpose of determining compliance with the specifications.

TRAINING - VIII

Prior to the acceptance of the first unit of each type, training shall be provided for the Department's engineering, consultants, maintenance and operations staff, at a facility provided by the Department. The training shall include all material and manuals required for each participant. The training shall be as follows:

8-1   Maintenance Training

The training shall be provided for a minimum of 40 hours for at least five (5) personnel with an electronics background. The training shall include operation instructions, theory of operation, circuit description, field adjustments, preventive maintenance procedures, troubleshooting and repair of all components.

8-2   Engineering Training

The training shall be provided for a minimum of 8 hours for at least twenty (20) engineering and operations personnel. The training shall include a complete demonstration of the operation and capabilities of the equipment. This session should include a complete review of any field adjustments or calibration of the computer equipment which may be necessary for optimum performance and should stress the ability to diagnose problems down to a faulty board or bad connector. In addition, the configuration of each board shall be discussed.

8-3   Software Training

The training shall be provided for a minimum of 40 hours for a minimum of five (5) experienced programmers. The purpose of the training is to review the use of the OS-9 development library specified in Section V. All procedures for developing operating OS-9 EPROM based applications shall be discussed. Any formal manuals and training notes utilized during the course shall remain the property of the students, at the conclusion of the session.

INSTRUCTIONS AND GUARANTEES - IX

9-1   One set of complete schematics and operations/maintenance manuals of each component shall be supplied with each five assemblies furnished. Maintenance manuals shall include complete sub-component parts listing.

9-2   No changes or substitutions in these requirements will be acceptable unless authorized in writing. Inquiries regarding this specification shall be addressed to the Manager, Office of ITS Engineering, New Jersey Department of Transportation, P.O. Box 613, 1035 Parkway Avenue, Trenton, New Jersey 08625.

9-3   All components shall carry a two-year guarantee from the date of acceptance against any imperfections in workmanship or materials.

9-4   The manufacturer agrees to, upon the request of the Manager, Office of ITS Engineering to deliver to the Office, a sample of each assembly to be supplied in compliance with these specifications for inspection and test before acceptance. After completion of the test, the sample shall be returned.

9-5   The supplier shall furnish any and all equipment which they deem necessary for safe and reliable field and central operation of the VME equipment as part of the quoted price for the specified equipment.

9-6   All components furnished under this specification shall be current production equipment and of recent manufacturer, identical models of which are in field operation in not less than one hundred sites. Untried or prototype units shall not be considered for acceptance.

9-7   All major components shall be identified with a metal plate containing the serial number with a bar code identification.

9-8   Any repairs made by a manufacturer or representative shall be documented and returned with units when warranty repaired. This documentation shall include an explanation of the exact repairs made and identification of parts replaced by part number and circuit number. All warranty repairs shall be completed within thirty days of delivery of the equipment to the designated repair depot.