

**ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARKANSAS
ARDOT - EQUIPMENT AND PROCUREMENT DIVISION
BID SHEET**

Contract No.: H-18-242P

BIDDER: _____

1. **4** – Overhead Dynamic Message Sign Assembly, to meet ARDOT Spec. **2018-02-DMS**

FOB: 4 ea. - ARDOT – Maintenance – ITS, 11300 W. Baseline Rd., Little Rock, AR 72209

Bid Price (Do not include any Local, State or Federal Taxes) Each \$ _____

Additional Units may be purchased at the same pricing and
conditions through _____
(Date)

BID TOTAL \$ _____

ATTACHMENT A

ELIGIBLE BIDDER CERTIFICATION

The Bidder represents and warrants for itself, its employees and its subcontractors and certifies they:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
2. Have not within a three-year period preceding thus Bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
3. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph two (2) of this Certification;
4. Have not within a one-year period preceding this application/Bid had one or more public transactions (Federal, State, or local) terminated for cause or default; and

The Bidder represents, warrants and acknowledges the understanding that restrictions placed on the employment of labor or on the scale of pay for the work on a contract will be the requirements of the Fair Labor Standards Act (Federal Wage-Hour Law) of 1938, 28 USC §201 et seq., and other applicable labor laws.

The person executing this Certification further represents, warrants and affirms the truthfulness and accuracy of the contents of the statements submitted on or with this Certification and understands that the provisions of 31 USC §3801 et seq. are applicable thereto.

BIDDER NAME

BY: _____

Signature

TITLE: _____

CONTRACT AND GRANT DISCLOSURE AND CERTIFICATION FORM

Failure to complete all of the following information may result in a delay in obtaining a contract, lease, purchase agreement, or grant award with any Arkansas State Agency.

SUBCONTRACTOR: _____ SUBCONTRACTOR NAME: _____

Yes No

IS THIS FOR:

TAXPAYER ID NAME: _____ Goods? Services? Both?

YOUR LAST NAME: _____ FIRST NAME: _____ M.I.: _____

ADDRESS: _____

CITY: _____ STATE: _____ ZIP CODE: _____ COUNTY: _____

AS A CONDITION OF OBTAINING, EXTENDING, AMENDING, OR RENEWING A CONTRACT, LEASE, PURCHASE AGREEMENT, OR GRANT AWARD WITH ANY ARKANSAS STATE AGENCY, THE FOLLOWING INFORMATION MUST BE DISCLOSED:

FOR INDIVIDUALS*

Indicate below if: you, your spouse or the brother, sister, parent, or child of you or your spouse is a current or former: member of the General Assembly, Constitutional Officer, State Board or Commission Member, or State Employee:

Position Held	Mark (✓)		Name of Position of Job Held <small>(senator, representative, name of board/ commission, data entry, etc.)</small>	For How Long?		What is the person(s) name and how are they related to you? <small>(i.e., Jane Q. Public, spouse, John Q. Public, Jr., child, etc.)</small>	
	Current	Former		From MM/YY	To MM/YY	Person's Name(s)	Relation
General Assembly							
Constitutional Officer							
State Board or Commission Member							
State Employee							

None of the above applies

FOR AN ENTITY (BUSINESS)*

Indicate below if any of the following persons, current or former, hold any position of control or hold any ownership interest of 10% or greater in the entity: member of the General Assembly, Constitutional Officer, State Board or Commission Member, State Employee, or the spouse, brother, sister, parent, or child of a member of the General Assembly, Constitutional Officer, State Board or Commission Member, or State Employee. Position of control means the power to direct the purchasing policies or influence the management of the entity.

Position Held	Mark (✓)		Name of Position of Job Held <small>(senator, representative, name of board/ commission, data entry, etc.)</small>	For How Long?		What is the person(s) name and what is his/her % of ownership interest and/or what is his/her position of control?		
	Current	Former		From MM/YY	To MM/YY	Person's Name(s)	Ownership Interest (%)	Position of Control
General Assembly								
Constitutional Officer								
State Board or Commission Member								
State Employee								

None of the above applies

Contract and Grant Disclosure and Certification Form

Failure to make any disclosure required by Governor's Executive Order 98-04, or any violation of any rule, regulation, or policy adopted pursuant to that Order, shall be a material breach of the terms of this contract. Any contractor, whether an individual or entity, who fails to make the required disclosure or who violates any rule, regulation, or policy shall be subject to all legal remedies available to the agency.

As an additional condition of obtaining, extending, amending, or renewing a contract with a state agency I agree as follows:

1. Prior to entering into any agreement with any subcontractor, prior or subsequent to the contract date, I will require the subcontractor to complete a **CONTRACT AND GRANT DISCLOSURE AND CERTIFICATION FORM**. Subcontractor shall mean any person or entity with whom I enter an agreement whereby I assign or otherwise delegate to the person or entity, for consideration, all, or any part, of the performance required of me under the terms of my contract with the state agency.

2. I will include the following language as a part of any agreement with a subcontractor:

Failure to make any disclosure required by Governor's Executive Order 98-04, or any violation of any rule, regulation, or policy adopted pursuant to that Order, shall be a material breach of the terms of this subcontract. The party who fails to make the required disclosure or who violates any rule, regulation, or policy shall be subject to all legal remedies available to the contractor.

3. No later than ten (10) days after entering into any agreement with a subcontractor, whether prior or subsequent to the contract date, I will mail a copy of the **CONTRACT AND GRANT DISCLOSURE AND CERTIFICATION FORM** completed by the subcontractor and a statement containing the dollar amount of the subcontract to the state agency.

Signature _____	Title _____	Date _____
Vendor Contact Person _____	Title _____	Phone No. _____

Agency Use Only				
Agency Number _____	Agency Name _____	Agency Contact Person _____	Contact Phone No. _____	Contract or Grant No. _____

RESTRICTION OF BOYCOTT OF ISRAEL CERTIFICATION

Pursuant to Arkansas Code Annotated § 25-1-503, a public entity **shall not** enter into a contract valued at \$1,000 or greater with a company unless the contract includes a written certification that the person or company is not currently engaged in, and agrees for the duration of the contract not to engage in, a boycott of Israel.

By signing below, the Contractor agrees and certifies that they do not boycott Israel and will not boycott Israel during the remaining aggregate term of the contract.

If a company does boycott Israel, see Arkansas Code Annotated § 25-1-503.

Bid Number/Contract Number	
Description of product or service	
Contractor name	

Contractor Signature: _____
Signature must be hand written, in ink

Date: _____

**Arkansas Department of Transportation
Specification 2018-02-DMS
Overhead Dynamic Message Sign Assembly**

A. General Conditions

1. Current Model: The units furnished under this specification shall be the latest improved model in current production, as offered to commercial trade, built for the US market, and shall be of quality workmanship and material. Machines manufactured for foreign markets will not be accepted. All equipment offered under this specification shall be new. Used, reconditioned, shopworn, demonstrator, prototype or discontinued models are not acceptable.
2. Delivery Requirements: It is the responsibility of the successful bidder to guarantee delivery of the Overhead LED Dynamic Message Sign Assembly as specified within the quoted time. The Arkansas Department of Transportation will not accept incomplete or late deliveries.
3. Manufacturer Requirements: The manufacturer shall have a minimum of 5 years of experience with the design, development, manufacturing, installation, testing, operation and maintenance of Dynamic Message Signs (DMS) for the transportation market. The manufacturer shall regularly and currently produce DMS. Experiences with manufacturing other types of electronic sign products will not satisfy the requirements of this DMS specification such as:
 - Indoor signs of any size or type
 - Portable or mobile signs of any size or type
 - Neon signs
 - Back-lit signs
 - Rotating drum or plank signs
 - LED lens Displays
 - Blank out signs
 - Any type of sign that is not pixilated and cannot be programmed to display a nearly infinite quantity of messages
 - DMS that have a pixel technology comprised of something other than high-intensity light emitting diodes (LED). Examples of unacceptable technologies are incandescent lamp, liquid crystal, fiber optic, flip disk, flip-fiber combination, and flip-LED combination
 - Outdoor electronic signs that are used for purposes other than roadway/motorway traffic management

At the ITS Management Section's request, the manufacturer shall document the total number of years it has been active in supplying DMS, the number of years at its current address, the number of employees. In addition the DMS manufacturer must have an in house Quality Management System (QMS) in place that is certified by an approved registrar to ISO 9001:2008 or the latest released standard of ISO 9001. The manufacturer's pre-build technical submittal must provide a copy of the company's ISO 9001 certification.

The manufacturer shall have manufactured DMS for at least 10 projects each with a minimum of 5 signs. These installations shall represent multiple state departments of transportation within the United States. These signs shall have been in operation for at least five (5) years prior to the let date of this contract. The DMS for existing installations shall be operated via remote communications including dial-up telephone, cellular telephone, spread spectrum radio, or fiber optic networks.

A summary of the installation base including the following shall be submitted with the technical submittal:

- Organization's name and country
- Contact person name, telephone number, fax number, and email address
- Date of project installation
- Summary of project scope and deployed sign characteristics

This manufacturer shall include three (3) references. The reference installations shall include DMS that have been installed and in production for at least five (5) years. Reference information shall include:

- Organization's name and country
- Contact person name, telephone number, fax number, and email address
- Date of project installation
- Summary of project scope

4. **Self-Certification:** The DMS manufacturer must provide self-certification, including a statement of conformance and copies of test reports, indicating that the following tests have been performed and passed.

Product test reports must be submitted for testing of the following National Transportation Communication for ITS Protocol (NTCIP) standards:

- *NTCIP 1201 NTCIP Global Object Definitions*
- *NTCIP 1203 Object Definitions for Dynamic Message Signs (including Amendment 1)*
- *NTCIP 2101 Point to Multi-Point Protocol Using RS-232 Subnetwork Profile.*

5. **Customer Service:** The DMS manufacturer must have a customer service department that provides technical support and services for the manufacturer's DMS systems. The manufacturer's customer service department shall be available via telephone, e-mail, and fax during business hours Monday-Friday. Third party call centers do not meet this requirement. The manufacturer must also offer bench level repair services for failed components and stocking of most parts for replacement. The manufacturer must maintain an online record of service requests and the actions taken to address and resolve the service issues.

The manufacturer must include a description of its available customer support services in the pre-build technical submittal.

Ensure that a manufacturer's representative is available to assist the ITS Management Section's technical personnel during pre-installation testing and installation.

6. **Product Testing:** Product test reports shall be submitted for the following testing:

- NEMA Standards Publication TS4-2016, Hardware Standards for Dynamic Message Signs (DMS), with NTCIP Requirements – Section 2, Environmental Requirements. Test report shall detail results of mechanical vibration and shock, electrical noise and immunity, temperature, and humidity.

The supplier must provide a record of each test performed including the results of each test. The report must include a record of the product test report and the test lab's representative that witnessed the tests, including the signature of the lab's representative. The test reports must be provided to the Engineer for review as part of the technical submittal.

B. Dynamic Message Sign Housing and Construction Specifications

1. **General:** The DMS housing shall provide front service access for all LED display modules, electronics, environmental control equipment, air filters, wiring, and other internal DMS components.

All DMS shall be front access at this time. Ensure front access signs meet the requirements of NEMA TS4-2016. Ensure access does not require specialized tools or excessive force.

The DMS shall contain a full display matrix that shall display messages that are continuous, uniform, and unbroken in appearance to motorists and travelers. The display area shall be capable of displaying three (3) lines of 15 characters using an 18-inch tall font that meets the height to width ratio and character spacing in the Manual of Uniform Traffic Control Devices for Streets and Highways 2009 Edition (MUTCD) or NEMA TS4-2016 Series D font.

The pixel matrix shall be capable of displaying at minimum alphanumeric 6" high characters in accordance with the definition defined by NEMA TS 4 Hardware Standards for Dynamic Message Signs Standards.

Each display pixel shall be composed of multiple red, green, and blue LEDs. Other pixel technologies, such as fiber optic, flip disk, combination flip disk-fiber optic, combination flip disk-LED, liquid crystal, LED lenses, and incandescent lamp, will not be accepted.

The DMS shall be able to display messages composed of any combination of alphanumeric text, punctuation symbols, and graphic images across multiple frames.

The overhead DMS shall be capable of being mounted to structures with a sign skew of up to 15 degrees off perpendicular to the roadway.

2. Legibility: DMS messages shall be legible from the DMS display face under the following conditions:
 - During daylight conditions and when the speed limit is 55+mph messages must be legible from a minimum of 800ft.
 - During night time conditions and when the speed limit is 55+mph messages must be legible from a minimum of 600ft.
 - When the DMS is mounted so its bottom side is positioned between five feet and 20 feet above a level roadway surface.
 - 24 hours per day and in most normally encountered weather conditions
 - During dawn and dusk hours when sunlight is shining directly on the display face or when the sun is directly behind (silhouetting) the DMS.
 - When the motorist eye level is 3 feet to 12 feet above the roadway surface.
3. Dimensions: DMS housing dimensions shall not exceed either 8 ft. high by 24 ft. wide or 192 square feet at the face. DMS weight shall not exceed 2500 pounds.
4. Sign Construction: DMS and sign controller components shall operate in a minimum temperature range of -30°F to +165°F (-34°C to +74°C) and a relative humidity range of 0 to 99%, non-condensing. DMS and sign controller components shall not be damaged by storage at or temporary operational exposure to a temperature range of -40°F to +185°F (-40°C to +85°C).

External DMS component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from hot dipped or mechanically galvanized steel, stainless steel, aluminum, nylon, or other durable corrosion-resistant materials suitable for the roadway signage application.

DMS and sign controller components shall be 100% solid-state, except for any environmental control fans and thermostats. DMS and sign controller components shall be designed to comply with applicable UL and NEC codes for DMS applications.

The presence of ambient radio signals and magnetic or electromagnetic interference, including those from power lines, transformers, and motors, shall not impair the performance of the DMS system. The DMS system shall not radiate electromagnetic signals that adversely affect any other electronic device, including those located in vehicles passing underneath or otherwise near the DMS and its sign controller.

5. DMS Sign Housing: The DMS housing shall be constructed to have a neat, professional appearance. The housing shall protect internal components from rain, ice, dust, and corrosion in accordance with NEMA enclosure Type 3R standards, as described in NEMA Standards Publication 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

All component parts shall be easily and readily accessible by a single person for inspection and maintenance. There shall be room for a technician to work. The housing shall be weather tight, and compliant to the NEMA 3R Standard.

The sign housing shall be capable of withstanding a wind loading of 90 mph without permanent deformation or other damages. The sign housing shall also be designed, stamped and signed by a Professional Engineer licensed in Arkansas to withstand current AASHTO specified group loading combinations including: sign weight, repair personnel and equipment, ice, and wind loads. The housing shall also meet strength requirements for truck-induced gusts as specified in NCHRP Report 412. The sign housing shall be engineered to withstand snow loading of 40 pounds per square foot, as well as the ability to be mounted in a manner that prevents the buildup of snow and creates a natural means by which snow can run off without impeding flow of traffic. The performance of the sign, including the visibility and legibility of the display, shall not be impaired due to continuous vibration caused by wind, traffic or other factors. The housing shall be designed to accommodate mounting on the rear vertical plane and shall be structurally sufficient to be mounted to the sign support structure. The sign housing and structural components for the system including bolts and welds, shall be structurally sufficient to perform under all applicable loading conditions including gravity, wind, traffic, weather, roadway deicers, maintenance, and other environmental factors.

Working/Shop drawings showing the sign housing and brackets shall be included in the technical submittals. All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. Painted steel is not acceptable. No self-tapping screws shall be used. The exterior front face surfaces shall be finish coated by a system that meets or exceeds the AAMA Specification No. 2605. The finish shall be matte black. The main body of the sign housing shall be constructed of aluminum with a natural mill finish.

6. Mounting Brackets: Multiple mounting brackets shall be bolted to the DMS housing exterior rear wall to facilitate attachment of the DMS to the support structure. Mounting brackets shall be:
- Attached to the DMS structural frame members, not just the exterior sheet metal.
 - Installed at the DMS manufacturer's factory.
 - Attached to the DMS using mechanically galvanized high-strength steel bolts.
 - Attached to the DMS using direct tension indicators to verify that mounting hardware is tightened with the proper amount of force.
 - Designed and fabricated such that the installing technician or contractor can drill into them without penetrating the DMS housing and compromising the housing's ability to shed water.
 - Installed such that all bracket-to-DMS attachment points are sealed and water-tight.
7. Lifting Hardware: For moving and installation purposes, multiple galvanized steel lifting eyebolts shall be attached to the top of the DMS housing. Eyebolt hardware shall attach directly to the DMS housing structural frame and be installed at the DMS factory. All mounting points for eyebolts shall be sealed to prevent water from entering the DMS housing. Lifting hardware, as well as the housing frame, shall be designed such that the DMS can be shipped and handled without damage or excessive stress being applied to the housing prior to or during DMS installation on its support structure.

The lifting eyebolts shall be easily removed by one individual without opening or entering the display and without any risk of compromising water-tightness. Special tools shall not be required.

Removal of the eyebolts shall not create holes and no replacement bolts or other hardware shall be necessary to seal the cabinet.

8. Exterior Finish: DMS front face panels and front face border pieces shall be coated with semi-gloss black polyvinylidene fluoride (PVDF), or preapproved equivalent, applied in accordance to American Architectural Manufacturers Association (AAMA 2605) which has an expected outdoor service life of 10 to 15 years.

All other DMS housing surfaces, including the DMS mounting brackets, shall be natural mill-finish aluminum.

9. Electronics: All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable, and individually removable using conventional electronics repair methods.

All cables shall be securely clamped/tied in the sign housing. No adhesive attachments will be allowed.

All Printed Circuit Boards (PCBs) shall be completely conformal coated with a silicone resin that meets the IPC CC-830 standard. The exception for this coating shall be the pixels on the front of the PCB of the LED motherboards and any components in sockets.

All discrete components, such as resistors, capacitors, diodes, transistors, and integrated circuits shall be individually replaceable. Components shall be arranged so they are easily accessible for testing and replacement. All circuit designs shall utilize high quality electronic components and shall provide a meantime before failure of at least 3 years.

The sign and the controller shall be capable of operating with 120/240 VAC, 50amp per leg, 60 Hz, single phase power.

10. LED Display Modules: The DMS shall contain LED display modules from one source that include an LED pixel array, and LED driver circuitry. Ensure the modules are fully interchangeable throughout the manufacturer's sign systems. These modules shall be mounted adjacently in a two-dimensional array to form a continuous LED pixel matrix. Ensure the display modules are rectangular and have an identical vertical and horizontal pitch between adjacent pixels. Ensure that the separation between the last column of one display module and the first column of the next module is equal to the horizontal distance between the columns of a single display module. Full-color signs must have a pitch **equal to or less than 35mm**. Each LED display module shall be constructed as follows:
- All LED modules shall be manufactured and designed to IPC standards.
 - Ensure that any devices used to secure LEDs do not block air flow to the LED leads or block the LED light output at the required viewing angle.
 - Ensure that all components on the LED side of PCBs are black.
 - Each LED display module shall be mounted to the rear of the display's front face panels using durable non-corrosive hardware. The modules shall be mounted such that the LEDs emit light through the face panel's pixel holes and such that the face panel does not block any part of the viewing cone of any of the LEDs in any pixels. The use of light enhancing lenses to achieve defined viewing cone shall be cause for rejection.
 - LED display module power and signal connections shall be a quick-disconnect locking connector type. Removal of a display module from the DMS shall not require a soldering operation.
 - All exposed metal on both sides of each printed circuit board, except connector contacts, shall be protected from water and humidity exposure by a thorough application of conformal coating. Bench level repair of individual components, including discrete LED replacement and conformal coating repair, shall be possible.

- Removal or failure of a single LED module shall not affect the operation of any other LED module or sign component. Removal of one or more LED modules shall not affect the structural integrity of any part of the sign.
- It shall not be possible to mount an LED display module upside-down or in an otherwise incorrect position within the DMS display matrix.
- All LED display modules, as well as the LED pixel boards shall be identical and interchangeable throughout the DMS.
- Ensure that the sign controller continuously measures and monitors all LED module power supply voltages and provides the voltage readings to the TMC or a laptop computer on command.

11. LED Pixels: Each LED module shall contain a printed circuit board to which LED pixels are soldered. Ensure that all pixels in all signs in a project, including operational support supplies, have equal color and on-axis intensity. Ensure that the sign display meets the luminance requirements of NEMA TS4-2016 Section 5.4 for light emitting signs connected at full power. Ensure that amber displays produce an overall luminous intensity of at least 9200 candelas per square meter when operating at 100% intensity. Provide the LED brightness and color bins that are used in each pixel to the Engineer for approval. Ensure that the LED manufacturer demonstrates testing and binning according to the International Commission on Illumination (CIE) 127 (1997) standard.

The LED pixel matrix shall conform to the following specifications:

- The distance from the center of one pixel to the center of all adjacent pixels, both horizontally and vertically, shall be ≤ 35 mm.
- Each pixel shall consist of a minimum of one (1) independent string of discrete LEDs for each color. All pixels shall contain an equal quantity of discrete LEDs.
- The failure of an LED string or pixel shall not cause the failure of any other LED string or pixel in the DMS.

12. Discrete LEDs: DMS pixels shall be constructed with discrete LEDs manufactured by a reputable manufacturer that has been in business for at least 10 years. Discrete LEDs shall conform to the following specifications:

- The LED packages shall be fabricated from UV light resistant epoxy.
- All LEDs shall have a nominal viewing cone of 30 degrees with a half-power angle of 15 degrees measured from the longitudinal axis of the LED. Viewing cone tolerances shall be as specified in the LED manufacturer's product specifications and shall not exceed ± 5 degrees. Using optical enhancing lenses with 15 degree LED's will not conform to 30 degree half-power viewing cone specifications and will be cause for rejection.
- The LED manufacturer shall perform color sorting of the bins. Each color of LEDs shall be obtained from no more than two (2) consecutive color "bins" as defined by the LED manufacturer.
- The LED manufacturer shall perform intensity sorting of the bins. LEDs shall be obtained from no more than two (2) consecutive luminous intensity "bins" as defined by the LED manufacturer.
- The various LED color and intensity bins shall be distributed evenly throughout the sign and shall be consistent from pixel to pixel. Random distribution of the LED bins shall not be accepted.
- The LED manufacturer shall assure color uniformity and consistency on the LED display face within the 30-degree cone of vision. Inconsistent color shifts or intensity will be cause for rejection.
- All LEDs used in all DMS provided for this contract shall be from the same manufacturer and of the same part number, except for the variations in the part number due to the intensity and color.

- The LEDs shall be rated by the LED manufacturer to have a minimum lifetime of 100,000 hours of continuous operation while maintaining a minimum of 50% of the original brightness.

13. Pixel Drive Circuitry:

- Each LED driver circuit shall be powered by 24 VDC from external regulated DC power supplies.
- The voltage of each power input shall be measured and reported to the sign controller as pass fail upon request. Each driver circuit shall also contain a status LED for the power supplies that indicates which voltage input is being used.
- The LED driver circuitry shall be able to detect that individual LED strings or pixels are stuck off and shall report the pixel status to the sign controller upon request.

14. Regulated DC Power Supplies: The LED pixel display modules shall be powered with a minimum of 2 auto-ranging regulated switching power supplies that convert the incoming AC to DC at a nominal voltage of 24 volts DC. Power supplies shall be wired in a redundant configuration that uses multiple supplies for the DMS display matrix.

Power supplies shall be redundant and rated such that if one supply or 25% of the supplies in a group, whichever is greater, completely fails, the remaining supply(s) shall be able to operate 40% of the pixels in that display region at 100% duty cycle when the internal DMS air temperature is +140°F (60°C) or less.

Each power supply shall receive 120VAC power from separate circuits on separate circuit breakers, such that a single tripped breaker will not disconnect power from more than one supply.

The power supplies shall be sufficient to maintain the appropriate LED display intensity throughout the entire operating input voltage range.

The power supplies used to power the LED pixel modules must be identical and interchangeable throughout the DMS.

The power supplies used to power the LED pixel modules shall have an application of acrylic conformal coating to protect from the environmental elements and must be UL listed or recognized.

The regulated DC power supplies shall conform to the following specifications:

- Automatic output shut down and restart if the power supply overheats or one of the following output faults occurs: over-voltage, short circuit, or over-current
- Power supplies shall be UL listed
- Printed circuit boards shall be protected by an acrylic conformal coating
- Nominal output voltage of 24 VDC +/- 10%
- Nominal maximum output power rating of 1000 watts
- Operating input voltage range shall be a minimum of 90 to 264 VAC
- Power supply efficiency shall be a minimum of 80%
- Power supply input circuit shall be fused

15. Environmental Monitoring Systems: A minimum of three photocells shall be installed on the sign. These devices shall permit automatic light intensity measurement of light conditions at each sign location. These photocells shall be mounted in a manner to measure front, rear and ambient light conditions.

Ensure the sign meets the requirements of NEMA TS4-2016. Ensure that the sensors provide accurate ambient light condition information to the sign controller for automatic light intensity adjustment. Ensure that the automatic adjustment of the LED driving waveform duty cycle occurs

in small enough increments that the sign's brightness changes smoothly, with no perceivable brightness change between adjacent levels. Ensure that stray headlights shining on the photoelectric sensor at night do not cause LED brightness changes.

16. Interior DMS Environmental Control: The ventilation systems for front-access DMS must meet the requirements of NEMA TS4-2016. Ensure the ventilation system may be tested on command from remote and local control access locations. Ensure the sign includes a sensor or a sensor assembly to monitor airflow volume to predict the need for a filter change. Ensure the ventilation system fans possess a 100,000-hour, L10 life rating. The DMS shall contain systems for cabinet ventilation and safe over-temperature shutdown.
17. Housing Ventilation System: Ensure the sign includes a fail-safe ventilation subsystem that includes a snap disk thermostat that is independent of the sign controller. Preset the thermostat at 130°F. If the sign housing's interior reaches 130°F, the thermostat must override the normal ventilation system, bypassing the sign controller and turning on all fans. The fans must remain on until the internal sign housing temperature falls to 115°F.

The ventilation system shall consist of two or more air intake ports. Each intake port shall be covered with a filter that removes airborne particles. One or more ball bearing-type fans shall be mounted at each intake port. These fans shall positively pressure the DMS cabinet. Ensure the ventilation system is automatically tested once each day and that it may be tested on command from remote and local control access locations. Ensure the sign includes a sensor or a sensor assembly to monitor airflow volume to predict the need for a filter change. Ensure the ventilation system fans possess a 100,000-hour, L10 life rating.

Fans and air filters shall be removable and replaceable from inside the DMS housing.

Ensure that the sign controller continuously measures and monitors the temperature sensors. Ensure that the sign blanks when a critical temperature is exceeded and that the sign will report this event when polled. Ensure that remote and local computers can read all temperature measurements from the sign controller.

One exhaust port shall be provided for each air intake port. All exhaust port openings shall be screened to prevent the entrance of insects and small animals.

An aluminum hood attached to the rear wall of the DMS shall cover each air intake and exhaust port. All intakes and exhaust hoods shall be thoroughly sealed to prevent water from entering the DMS.

The DMS shall automatically shut down the LED modules to prevent damaging the LEDs if the measured internal cabinet air temperature exceeds a maximum threshold temperature.

18. Transient Protection: Provide surge protective devices (SPD) installed or incorporated in the sign system by the manufacturer to guard against lightning, transient voltage surges, and induced current on both sides of all electronics.

The system power shall be protected by two stages of transient voltage suppression devices. Also, communication lines shall be protected by two stages of transient voltage suppression devices as required in the Sign Controller Communication Interface section of this specification. In both cases, tripping of each stage (or both if tripped simultaneously) of the surge protection shall cause the sign controller to call central and report the error condition.

C. Manufacturer-Supplied Sign Controller Specifications

1. General: Ensure that the sign controller monitors the sign in accordance with NEMA TS-2016, Section 9. Ensure the sign monitors the status of any photocells, LED power supplies, humidity,

and airflow sensors. Ensure sign controllers use fiber optic cables for data connections between the sign housing and ground-level cabinet. If required, media converters and/or any other associated equipment are considered acceptable to accompany fiber optic connections to ensure connectivity between devices. Ensure that the sign controller is capable of displaying a self-updating time and date message on the sign. Ensure that sign controllers within cabinets are rack-mountable, designed for a standard EIA-310 19 inch rack, and include a keypad and display. Users should be able to edit operating parameters (such as flash rate, on and off times, calendar functions, blinking, etc.)

Each DMS shall be controlled and monitored by a sign controller. The sign controller may monitor a single or multiple DMS. The sign controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with DMS control software in order to perform most DMS control functions.

The sign controller shall meet the following operational requirements:

- Communicate using embedded NTCIP protocol
 - Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
 - Include a front panel user interface graphical LCD and keypad for direct operation and diagnostics as described herein
 - The sign controller shall have a minimum of one 10/100 Base-T Ethernet communication port with RJ45 connector for network connection.
 - Ensure that the TMC or a laptop computer can be used to remotely reset the sign controller.
2. Front Panel Interface: This sign controller's front panel shall include a menu driven graphical LCD with key pad. User should be able to complete the following operations with the front panel interface:
- Monitor the current status of the sign controller, including the status of all sensors and a RGB what-you-see-is-what-you-get (WYSIWYG) representation of the message visible on the display face
 - Perform diagnostics testing of various system components, including pixels, power systems, sensors, and more
 - Activate, create, preview, and delete messages stored in memory
 - Blank the sign
 - Start and stop the schedule
 - Configure display parameters, including display size and color technology
 - Configure date and time
 - Configure communications port settings and NTCIP options
 - Configurable level of password protection per user
 - Control brightness levels

The sign controller shall have an electronic changeable memory. This memory shall be formed by flash or battery-backed static RAM integrated circuits that retain the data in memory for a minimum of 30 days following a power loss. This changeable memory shall be used to store messages and schedules.

The DMS sign controller shall contain a computer-readable clock that has a battery backup circuit. The battery shall keep the clock operating properly for at least 30 days without external power, and the clock shall automatically adjust for daylight savings time and leap year using hardware, software, or a combination of both.

3. Communication, Message and Status Monitoring:

The DMS should provide two modes of operation:

- a. Remote operation, where the TMC or a remote laptop commands and controls the sign and determines the appropriate message or test pattern
- b. Local operation, where the sign controller or an onsite laptop computer commands and controls the sign and determines the appropriate message or test pattern.

The DMS should perform the following functions:

- a. Control Selection - Ensure that local or remote sign control can be selected. Ensure that there is a visual indicator on the controller that identifies whether the sign is under local or remote control.
- b. Message Selection - Ensure that the sign controller can select a blank message or any one of the messages stored in the sign controller's nonvolatile memory when the control mode is set to local.
- c. Message Implementation - Ensure that the sign controller can activate the selected message.

Ensure that the sign can be programmed to display a user-defined message, including a blank page, in the event of power loss. Ensure that message additions, deletions, and sign controller changes may be made from either the remote TMC or a local laptop computer. Ensure that there is no perceivable flicker or ghosting of the pixels during sign erasure and writing periods.

4. DMS Control Outputs: The DMS sign controller shall transmit and receive data packets to and from the DMS via dedicated fiber optic cables. Data transferred shall include pixel states, sensor values, and I/O readings from various devices, such as door sensors and power supply monitors. Pixel data shall include the states to be displayed on the sign face as well as diagnostic data retrieved from the LED drivers.
5. Ethernet Port: The DMS sign controller shall contain a minimum of one (1) 10/100Base-T Ethernet communication port. This port shall be available for communicating from the central control system to the DMS sign controller when an Ethernet network is available. The Ethernet port shall have a standard RJ45 connector.

Communications on the Ethernet port shall be NTCIP-compatible using the NTCIP 2202 Internet transport profile and the NTCIP 2104 Ethernet sub network profile. This shall permit the controller to be operated on any typical Ethernet network using the TCP/IP and UDP/IP protocols.

6. Controller Addressing: The DMS sign controller shall use whatever addressing scheme is appropriate for the NTCIP network types used for communications. The controller addressing shall be configurable through the front panel user interface.

NTCIP 2101 (PMPP) networks shall be configured with an address in the range 1 to 255 with a default address of 1. NTCIP 2104 (Ethernet) networks shall use a static IP address. Both the IP address and subnet shall be configurable.

7. Transient Protection: The Ethernet communication ports in the DMS sign controller shall be protected with surge protection between each signal line and ground. This surge protection shall be integrated internally within the controller.
8. Traffic Cabinet: The sign controller and all necessary electronics for communication with the DMS shall be mounted in an aluminum traffic cabinet that meets or exceeds NEMA 3R standards for an outdoor enclosure. Pole-mount style traffic cabinet is preferred. The cabinet must be of size that will accommodate a 19" rack mounted sign controller, and of a height suitable for containing all required hardware with ease of access.

D. Messaging

The DMS controller shall have the ability to display messages on the DMS display face as required herein.

1. Message Presentation on the DMS Display Matrix: The sign controller shall control the LED drivers in a manner that causes the desired message to display on the DMS sign. At a minimum, the sign controller shall support the following features as described in the DMS specification:

- Display of alpha numeric characters, including letters, numbers, and punctuation
- Selection of particular character fonts style
- Full graphic capabilities
- Horizontal alignment of text on the display, including left, center, and right justification
- Vertical alignment of text on the display, including top, middle, and bottom justification
- Adjusting the spacing horizontally between characters or vertically between lines of text
- Alternating between pages of a multiple-page message
- Travel time capabilities
- Must be able to display various interstate symbols such as badges and shields containing the appropriate interstate numbers
- Display of graphic bitmaps or jpeg files of various sizes ranging to very small to the size of the entire DMS matrix

2. Message Effects: The DMS shall be able to display messages using the following types of effects:

- Static Message – The selected message is displayed continuously on the sign face until the sign controller blanks the sign or causes the display of another message
- Flashing Message – All or part of a message is displayed and blanked alternately at rates between 0.1 seconds and 9.9 seconds. The flash rate is user programmable in increments of 0.1 seconds
- Scrolling Message – The message moves across the display face from one side to the other. The direction of travel is user selectable as either left-to-right or right-to-left
- Multiple-Page Message – A message contains up to six different pages of information, with each page filling the entire pixel matrix. Each page's display time is user programmable from 0.1 seconds to 25.5 seconds, and adjustable in increments of 0.1 seconds.

3. Message Activation: Messages shall be activated on a DMS in three ways:

- Manual – An operator using the front panel LCD/keypad interface or NTCIP-compatible control software manually instructs a particular message to be activated.
- Schedule – The internal time-based scheduler in the DMS may be configured to activate messages at programmable times and dates. Prior to activation, these messages and their activation times and dates shall be configured using the control software.
- Events – Certain events, like a power loss, may trigger the activation of pre-configured messages when they occur. These events must be configured using the control software.

A displayed message shall remain on the sign until one of the following occurs:

- The message's duration timeout expires
- The controller receives a command to change the message
- The controller receives a command to blank the sign
- The schedule stored in the controller's memory indicates that it is time to activate a different message
- A special event, such as a loss of communication, occurs that is linked to message activation

It shall be possible to confer a “priority” status onto any message (such as a Morgan Nick Amber Alert), and a command to display a priority message shall cause any non-priority message to be overridden.

4. Schedule Activation: The DMS sign controller shall support the activation of messages based on a time/date-based schedule. The format and operation of the message scheduler shall be per the NTCIP 1201 and NTCIP 1203 standards.
5. Display of Alphanumeric Text: The DMS sign controller shall support the storage needed for all installed fonts and static sign graphics. All fonts and graphics shall be submitted to the engineer for approval. Each font shall support up to 255 characters. All text font files shall include the following characters:
 - The letters “A” through “Z”, in both upper and lower case
 - Decimal digits “0” through “9”
 - A blank space
 - Eight (8) directional arrows
 - Punctuation marks, such as: . , ! ? - ‘ ’ “ ” ; :
 - Special characters, such as: # & * + / () [] < > @

E. Material, Manufacturing, and Design Standards

Manufacturer shall ensure that all products supplied meet or exceed industry standards including:

1. General DMS Requirements – The DMS shall be designed in accordance with *NEMA Standards Publication TS4 - 2016, Hardware Standards for Dynamic Message Signs (DMS), with NTCIP Requirements*.
2. Aluminum Welding – The DMS housing must be designed, fabricated, welded, and inspected in accordance with the latest revision of *ANSI/AWS D1.2 Structural Welding Code-Aluminum*.
3. Electrical Components – High-voltage components and circuits (120 VAC and greater) shall be designed, wired, and color-coded per the National Electric Code.
4. Environmental Resistance – The DMS control and power enclosure shall be designed to comply with type 3R enclosure criteria as described in *NEMA Standards Publication 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum)*
5. Radio Frequency Emissions – All equipment shall be designed in accordance with Federal Communications Commission (FCC) Part 15, Subpart B as a “Class A” digital device.
6. Product Electrical Safety – The DMS and associated equipment and enclosures shall be designed to comply with applicable UL and NEC codes for DMS applications.
7. Structural Integrity – The DMS housing shall be designed and constructed to comply with all applicable sections of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 4th edition (2001) with 2003 and 2006 Interims. , as well as the fatigue resistance requirements of NCHRP Report 412, Fatigue-Resistant Design of Cantilevered Signal, Sign, and Light Supports.
8. Communication Protocols – The sign controller hardware/firmware and DMS control software shall conform to the applicable National Transportation Communication for ITS Protocol (NTCIP) standards. The NTCIP testing must have been completed using industry accepted test tools such as the NTCIP Exerciser, Trevilon’s NTester, Intelligent Devices’ Device Tester, and/or Frontline’s FTS for NTCIP.

F. Performance Test

This item shall consist of the manufacturer providing a six (6) month guarantee and proving the soundness of the DMS assembly and related electrical components to be installed at department specified locations. This guarantee period begins on the date of acceptance by the ITS Management Section.

The ITS Management Section shall conduct a performance test, which shall consist of a continuous 30 day period of operation without a major malfunction after installation. A major malfunction is considered to be any occurrence, other than a power or communication failure beyond the ITS Management Section's control that renders the installation inoperative for more than five (5) minutes.

If the DMS cannot be repaired such that the performance test can be resumed within 48 hours of notification of a failure of defect then the 30 day performance test shall start over at Day 1 on successful repair of the DMS to the ITS Management Section's satisfaction.

Defective equipment or accessories shall be repaired or replaced according to applicable specifications and to the satisfaction of the ITS Management Section within 30 days during the warranty period.

The manufacturer shall assign to the Department transferable manufacturers' warranties or guarantees on all electrical and mechanical equipment, consistent with those provided as customary practice. The manufacturer's warranty transferred to the Department shall be for a period of at least two (2) years.

G. Technical Submittal

The DMS manufacturer must provide a complete pre-build technical submittal within 30 days of contract award and shall not proceed with DMS manufacture until the ITS Section has approved the submittal. The DMS manufacturer shall provide one (1) copy of the submittal in electronic format.

The submittal must include:

- All DMS manufacturer qualification information, as specified herein
- DMS shop drawing, including an illustration of the recommended installation method
- AC power requirements, including the number of legs, current draw per leg, and typical site power consumption
- Major DMS schematics in block diagram form, including AC power distribution inside and outside the DMS, DC power distribution within the DMS, and control signal distribution inside and outside the DMS
- Drawings of major DMS components, including LED display modules, driver boards, control/logic components, environmental control assemblies, DMS sign controller, control equipment cabinet assembly, and control cabinet mounting footprint
- Catalog cut sheets for major DMS components, including front face paint material, polycarbonate face material, LEDs, regulated DC power supplies, circuit board conformal coating material, hookup wire, signal cable, surge suppression devices, panel board, circuit breakers, utility outlets, sign controller, ventilation/cooling fans, heaters, ventilation filter, thermostats, and any other major system components
- Test reports and certification for all items identified in the "Product Testing" specifications herein

The pre-build submittal shall also include the following background information about the DMS manufacturer:

- Full corporate name with corporate address
- Contact person name, telephone number, fax number, and email address

- Names and qualifications of the primary project team members, including the following: sales person, project manager, product manager, application engineer, and manufacturing manager
- Number of years in business under the current corporate name
- Copy of the DMS manufacturer's in-house quality management system
- Copy of the DMS manufacturer's certified welding procedure
- General corporate literature
- DMS product literature

Failure to provide complete and accurate submittal information, as specified herein, will be cause for rejecting the DMS manufacturer.