



**TELEGRA**

*Smart Traffic Management®*

3030 LBJ FREEWAY  
SUITE 1385  
DALLAS, TEXAS 75234  
phone 972.241.3535  
1.877.282.3535



# **ARCHITECT/ENGINEER SPECIFICATIONS**

**For**

## **Dynamic Message Sign Systems**

**Telegra, Inc.  
3030 LBJ Freeway, Suite 1385  
Dallas, TX 35234  
Tel: (972) 241-3535  
Fax: (972) 241-3574  
[www.telegra-inc.com](http://www.telegra-inc.com)**

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# **Architect/Engineer Specifications Dynamic Message Sign Systems**

## **1. Overview**

This document has been prepared for use by Architects and Engineers for the purpose of developing Dynamic Message Sign (DMS) system procurement specifications. Users may utilize information contained in this document, in whole or in part, as recommended functional and performance standards. It is assumed that users are industry professionals with a working knowledge and comprehensive understanding of DMS products and utilization.

## **2. Glossary**

Abbreviations used in this document are defined as follows:

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
AWS	American Welding Society
CUL	Canadian Underwriters Laboratories
DDD	Detailed Design Document
DMS	Dynamic Message Sign
EC	European Communities
EMF	Electro-Magnetic Field
FAT	Factory Acceptance Test
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
ISO	International Standards Organization
ITS	Intelligent Transportation System
LED	Light Emitting Diode
NEMA	National Electrical Manufacturers Association
NTCIP	National Transportation Communications for ITS Protocol
PCB	Printed Circuit Board
RFC	Roadside Field Controller
RoHS	Restriction of Hazardous Substances
UL	Underwriters Laboratories
VAC	Volts Alternating Current
VDC	Volts Direct Current
VMS	Variable Message Sign

## **3. Manufacturer Qualifications**

DMS manufacturers shall meet the following minimum qualification criteria:

- Be a qualified manufacturer of complex technology-based hardware and software for use in the intelligent transportation industry.
- A proven track record of at least continuous ten (10) years in the manufacture of LED variable message signs for use with advanced traffic management, intelligent

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transportation, electronic toll collection, highway and freeway management, transit operations, airport land-side operations, or parking facilities.

- A minimum of three thousand (3,000) LED variable message signs manufactured and delivered globally and in operation for a period of at least one (1) year, utilizing National Transportation Communications ITS Protocol (NTCIP) or other communications protocols.
- Be certified by recognized international bodies including the following:
  - UL and CUL Listed
  - UL48, UL1433 & UL50
  - Approved for EN-12966, TUV, CE, RoHS, BAST and ISO 9001:2000
  - Compliance with NEMA TS4, NTCIP, and ITE requirements
  - ANSI, IEEE, AASHTO, and AWS certification criteria
  - EC60068-2-64 standard for vibration and shock endurance
  - MIL-STD-810F standard for sand and dust, vibration and icing/freezing rain
  - EC60950-1, HD384.4, HD638 safety standards
  - EC60529 standard for enclosure protection

#### **4. Documentation & Manuals**

DMS manufacturers shall provide complete and comprehensive design, installation, operating and maintenance documentation proposed for use on a specific project or application as follows:

Design Documents: Detailed technical specifications, drawings, literature and documentation depicting all hardware, electronic components, parts, wiring, cables, connectors, structural components, software and procedures used in the manufacturing of sign displays and field controller equipment.

Installation Documents: Detailed installation, handling, shipping and testing procedures for sign displays and field controller equipment.

Operating Manuals: Detailed operating procedures for sign displays and field controller equipment.

Maintenance Manuals: Detailed preventative maintenance, troubleshooting and repair procedures for sign displays and field controller equipment.

#### **5. General Requirements**

DMS sign systems shall be designed and manufactured based on the following general requirements:

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- Ability for remote control from a traffic management center
- Ability to be integrated with any advanced traffic management system
- Ability to operate in temperature ranges of -40°F to +165°F
- Adjustable light intensity of each LED from 0 to 100% in 1% increments
- Applied communication protocols shall be NTCIP compliant
- Autonomous local operation; no need for control center in critical situations
- Certified for highest optical requirements in accordance with NEMA TS-4
- Client/Server architecture designed for server and multiple client modules over TCP/IP
- Communications interface by means of copper wire, fiber optics, serial, Ethernet or wireless
- Communications protocols (NTCIP, TLS, TLS over IP, Profibus, OPC, XML)
- Communications via RS485/422/232, Ethernet, GSM/GPRS, Bluetooth or wireless
- Components used in manufacturing shall be RoHS Compliant
- Conformance with NEMA TS-4 hardware standards for Dynamic Message Signs
- Conformance with NTCIP for ITS protocol
- Conformance with the NEMA TS4 Hardware Standard for Dynamic Message Signs
- Control and drive circuitry for individual LEDs
- Customized dimensions, color combinations and pixel pitch options
- EC declaration for conformity to EN12966 - 2005
- Effective use in tunnels and on open roads above traffic lanes
- Enhanced EMC immunity
- Enhanced message and graphic image quality
- Environmental monitoring (thermostat, hydrostat, ventilation system)
- Error detection and event logging for each pixel in both “on” and “off” states
- Extended display uniformity due to use of PCBs in all applications
- Extensive set up and fault diagnostics with local cable or wireless connection
- External housing designed for harsh (extreme cold and heat) outdoor environments
- Fail-safe operation to increase safety in traffic applications with auto-testing on at least 3 levels, namely communication, power and functionality (LEDs, modules)
- Field integration with various sub-systems using direct field bus connection (in-field horizontal system integration)
- High mechanical protection
- High processor power and high speed communication interfaces enable display of prerecorded sequences of pictures if needed
- Highly durable self-cleaning front-panel lenses minimize system disruption and down times
- Highly recognizable symbol uniformity with character display in TrueType fonts
- Independent control, adjustment and reporting on every single LED
- Individual LED current control and anti-aliasing techniques
- Intelligent LED control and drive modules with or without multiplexing
- Latest generation of LEDs
- LED error detection in “on” and “off” state of individual LEDs
- LED feed-through mounting on printed circuit boards

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- Long-life LED operation assured through low average LED current
- Low cost of ownership over extended equipment lifetime
- Low LED current drive, operating temperature and extensive environmental control
- Low power consumption and modular design
- Measurement and monitoring of internal environmental (temperature, humidity) conditions with safety alerts
- Measurement of ambient sunlight and automatic LED intensity adjustment
- Monochromatic and full color display PCB modules for easy maintenance
- No manufacturer's proprietary protocol applications
- Optical properties according to NEMA TS-4; EN12966 L2-L3(T)(\*), R2-R3, B1-B7, C2
- Power supply input of 120/240 VAC, 50/60Hz
- Sign display can store up to 100 pre-programmed messages
- Specially designed optical system applies lower current through the LED to increase light intensity, improving LED light output and efficiency while significantly increasing LED life
- Stand-alone system manager (Windows XP and handheld PDA versions)
- State-of-the-art color mixing technology for increased luminance on RGB full color signs
- State-of-the-art prismatic optical system for superior clarity and high contrast ratios while optimizing light output, LED performance and longevity
- Superior uniformity and symbol shaping (no aliasing on displays)
- Symbol display sequences at a rate of 10 symbols per second
- Temperature supervision modules
- Utilize an external ambient light intensity measuring module
- Versatile connectivity options (all physical and electrical media, different protocols)
- When a commanding sign controller fails, the affected DMS or displayed image shall remain "as it is" (default), or can be changed or turned off automatically (if so programmed)

## **6. LED Display Attributes**

LED sign display modules shall be designed and manufactured based on the following attributes:

- Average current through each LED shall not exceed recommended operating conditions
- If a malfunction is detected in the Driver or Display Modules, the LED power supply can immediately be turned off to prevent displaying false pictures on the signs.
- Each LED in a display module shall have its own current source to enable anti-aliasing effects when displaying symbols and text applied in matrix displays
- Each LED will have its own adjustable intensity level, including during rough pixel pitch to ensure high quality and recognizable images
- Internal temperature shall be measured (potential hot-spots in a housing or on a power supplies are monitored) and the internal temperature data sent the control center through an internal microprocessor driven control module

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- LED current sources shall be monitored to enable the detection of current source malfunction, where operators receive information if the LEDs are turned on
- LED Display Modules shall be precisely screwed to the front panel, ensuring very high uniformity of displayed symbols
- LED drivers shall be placed on PCB driver boards
- LEDs shall be through-hole mounted on PCBs
- Low current drive shall ensure long-life of all LEDs and low degradation of light output throughout the life of the sign display
- Power supply modules shall have separate outputs for LED supply and logic control
- Driver board modules shall constantly check the condition of LEDs, even when they are turned off (“cold state testing”)
- Driver board modules shall have the ability to drive LEDs continuously, as well as in multiplex mode
- Driver board modules are attached to the LED Display Modules by connectors and holders
- Driver board modules shall be connected to a controller which shall consist of a 32bit MCU with logic and memory to store up to 100 different symbols and images

### 7. System Block Diagram

The following block diagram represents the logical structure of a typical Dynamic Message Sign and serial communications over fiber optic lines for communication with field controller equipment:

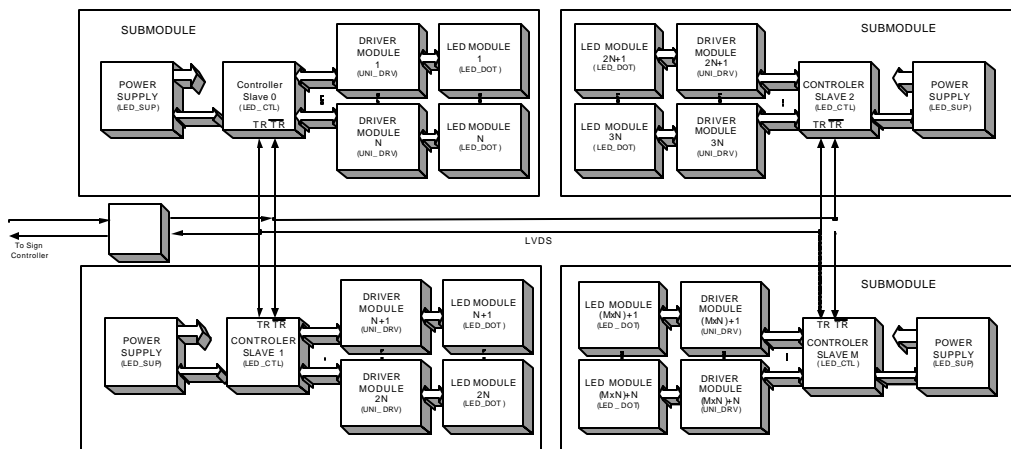


Fig.1: Block schematic of DMS technology

## **8. Message Display**

Display of text and special characters shall be true type fonts of various heights. True type font definitions (letter width definition, spacing ratios between letters, etc.) shall be stored in read-only memory of the sign controller.

The sign controller shall receive text data via its communication port and generate an image which shall be displayed on the sign display based on font definitions. LEDs on letter edges shall be displayed in grayscale in order to smooth displayed text. LED message displays shall be designed and manufactured based on the following requirements:

- Beam width: B1-B7
- Character heights shall be adjustable to 9", 12", 18" or 24"
- Classification Luminance ratio: R2-R3
- Color class: C2 in amber or RGB
- Contrast Ratio R2-R3 according to EN 12966
- EN 12966 Compliance LED intensity (luminance): L3, L3(\*), L3t
- All standard graphical formats: JPEG, BMP, WMF and more
- IP protection: P2, P3 (IP55 – IP56)
- LED Color class C2; various dimensions and combinations
- Discreet control of each LED
- Message display formats shall be alpha-numeric static, multi-page and scrolling text
- Optional flashing signals can be installed on sign to alert drivers
- Minimum pixel pitch of 12 mm (.5 inches)
- Temperature: T1, T2, T3 (-40° to +165°F)
- The VMS display shall have the capability for anti-aliasing (grayscale smoothing) for improved image display.

The following figures illustrate utilization of raster text and grayscale smoothing.



Figure 2: Text to be displayed

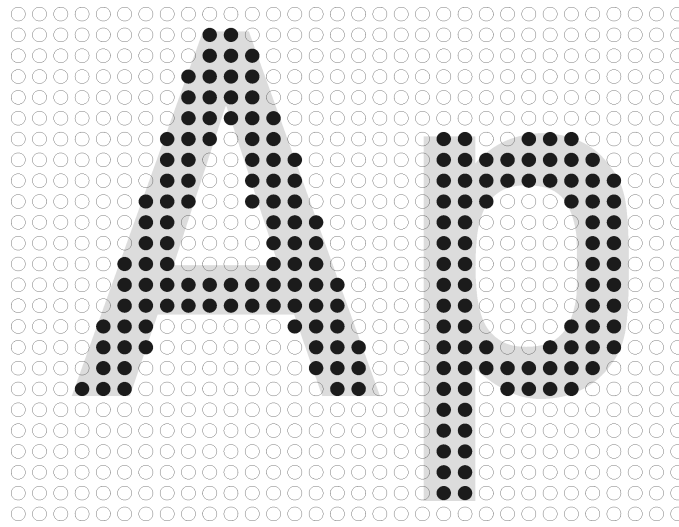


Figure 3: Approximation of text without text smoothing



Figure 4: Displayed text as result of text smoothing (anti-aliasing)

## **9. Sign Enclosure Attributes**

DMS sign enclosures shall be designed and manufactured based on the following requirements:

- Cabinet Welding Process and fabrication meet ISO EN 131 (GMAW process) and ISO EN 141 (GTAW process) standards; also certified for EN 287
- Exterior Finish Electrostatic powder coating with chemical preparation using TIGER Drylac RAL matte (based on polyester)
- Front face shall be a two-component black matte paint for low light reflection and maximized contrast

## **10. Local Field Controllers**

Field controllers shall serve as a communication concentrator to gather data from all DMS devices. Each DMS is controlled via its own sign controller installed within the field controller cabinet. A 19-inch rack mountable modular design shall be provided to allow future expansion and the ability to add new DMS by upgrading the controller's firmware. In the event of communication failure between the field controller and traffic management center, the DMS can be controlled locally, based on traffic and weather information or predefined algorithms.

The field controller shall be capable of communicating with a variety of ITS products and subsystems and shall provide autonomous local operation using high processing power to allow for control of road sections in the absence of a traffic management center, or in the event of a network failure. With a large non-volatile memory buffer, the field controller shall have the ability to control other equipment and connect directly to other subsystems using field bus protocols.

The DMS field controller shall be designed and manufactured based on the following requirements:

- **Data Processing and Data Management** – Manages and processes real time data transmitted between the main traffic control center and sensors in the road
- **Message Activation** – Activates the message displays on LED dynamic message signs and other intelligent traffic devices with the ability to store a minimum of 500 pre-programmed messages
- **Data Storage** – Stores traffic data, which can be retrieved locally by replacing the memory card or remotely via internet download
- **Versatile Design** – Offers customized configuration of hardware components and accommodates a wide range of control and monitoring functions, satisfying the most demanding ITS applications
- **Versatile Connectivity** – Provides options to communicate to the control center or directly to roadside equipment via fiber-optic networks, twisted pair, wireless, or internet.
- **Integration** – Supports a large number of interfaces and protocols for full in-field integration with other systems
- **System Protection** – Assumes control of traffic equipment using input from road devices, if communications with the traffic control center breaks down

Field controllers shall be designed to automatically assume control and switch to a local mode in the event of a communication failure with the control center. The field controller shall meet or exceed all international standards for the most stringent mechanical and environmental requirements and shall be compliant with the following standards:

- NEMA 3R cabinet design and fabrication
- UL and CUL listed

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- Compliant with NTCIP for ITS protocol
- Safety standards in accordance with IEC 60950-1
- EMC compliant with applicable electromagnetic interference immunity levels
- TLS2002 homologated and compliance tested

## **11. System Power Requirements**

DMS sign displays and field controllers shall be designed based on the following power requirements:

- Automatic fuses shall serve as over-current protection
- Compliant with EN 50293:2000: electromagnetic interference immunity levels
- Compliant with EN 55014-1: terminal disturbance voltage, discontinuous, clicks
- Compliant with EN 55022: radiated emissions, class: B
- Compliant with EN 55022: terminal disturbance voltage, class: B
- Compliant with EN 61000-3-2: limits for harmonic current emissions, class: A
- Compliant with EN 61000-3-3: voltage fluctuations and flicker low voltage supply system
- Compliant with EN 61000-4-11: voltage drop immunity, interruptions & voltage variations
- Compliant with EN 61000-4-2: immunity to electrostatic discharge, failure criteria: B
- Compliant with EN 61000-4-3: radiated electromagnetic field immunity, failure criteria: A
- Compliant with EN 61000-4-4: fast transient immunity (burst), failure criteria: B
- Compliant with EN 61000-4-5: surge immunity, failure criteria: B
- Compliant with EN 61000-4-6: high frequency interference immunity, failure criteria: A
- EMC filter shall be connected to the power supply to filter electro-magnetic disturbances
- Over-voltage protection connected directly to the main power supply lines to conduct charge caused by lightning or any over-voltage disturbance directly to the ground
- Power Requirements of 120-240VAC, 50-60Hz; low power consumption; power consumption for walk-in model signs may vary due to environmental factors
- Signal lines protected in three stages using discharge tubes, varistors & suppressor diodes
- Stabilized DC Power Supply of 5VDC-12VDC

## **12. Testing & Support**

The DMS manufacturer shall provide comprehensive technical support during all factory acceptance testing and field acceptance testing activities, as may be designated for specific projects and applications.

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**13. Quality Control & Assurance**

All DMS sign display and field equipment shall be manufactured using state-of-the-art programmable manufacturing techniques and utilize quality control and assurance practices in accordance with ISO 9001-2000 requirements.

**14. Warranty**

All DMS sign display and field controller equipment shall be furnished with a ten (10) year warranty on the enclosures and a two (2) year warranty on electronic components and services.

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