TAMPA-HILLSBOROUGH COUNTY EXPRESSWAY AUTHORITY

ADDENDUM NO. 1

FOR

REQUEST FOR QUALIFICATIONS

ITS NETWORK SUPPORT SERVICES

RFQ No. O-01218
ADDENDUM NO. 1

PROJECT NAME: ITS Network Support Services ~ DATE OF ADDENDUM: 12/14/18

TO ALL PROSPECTIVE BIDDERS:

PLEASE NOTE THE FOLLOWING ADDENDUM TO THE RFQ:

The following are documents are added to the subject project:

1. Cohu Camera Documents
2. DMS Model & Description
3. DMS Specification Documents
4. Rugged Switch Specifications
5. Video Wall Specifications

Bidders MUST acknowledge receipt of this Addendum by signing, dating and returning the completed Acknowledgement of Receipt of Addendum form with Bidder’s proposal.

All other items, conditions, and specifications in the ITB document not specifically changed by the Addendum remain unchanged.

Bidders failing to acknowledge the addendum issued may be deemed non-responsive to the LOI. Please send all questions to THEA’s Procurement Manager, Man Le, via email at Man.Le@tampa-xway.com.
ACKNOWLEDGEMENT OF RECEIPT OF ADDENDUM and/or LETTER OF CLARIFICATION

Were Addenda issued on this Solicitation?

☐ Yes
☐ No

Were Letter of Clarification issued on this Solicitation?

☐ Yes
☐ No

I (We) hereby acknowledge receipt of the following Addendum/Addenda issued in reference to this solicitation by listing the Addenda by number, date and signing the form:

<table>
<thead>
<tr>
<th>Addendum</th>
<th>Date: ____________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addendum</td>
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<tr>
<td>Addendum</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Letter of Clarification</th>
<th>Date: ____________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter of Clarification</td>
<td>Date: ____________________</td>
</tr>
<tr>
<td>Letter of Clarification</td>
<td>Date: ____________________</td>
</tr>
</tbody>
</table>

BIDDER:

By: ___________________________________
    Authorized Signature

___________________________________
    Printed Name of Signer

___________________________________
    Title of Signer

___________________________________
    Date Signed

[END OF ACKNOWLEDGMENT OF RECEIPT FORM]
Advanced Optics
- Superior 1080p image quality
- Powerful 30x optical zoom with 12x digital zoom (360x total)
- Image defog/dehaze analytics
- Electronic image stabilization (EIS)
- Dark scene enhanced intensity
- Bright source whitout reduction

Rugged Construction
- Operates in hurricane force winds
- Built-in electrical transient/surge protection to CISPR 24 levels
- Purged and pressurized IP67 ingress protection
- NEMA TS2 temperature range, -40°C to 75°C

Flexible Installation and Seamless Interoperability
- ONVIF Profile S compliant
- NTPC 1205 camera control compliant
- User defined video stream profiles
- Presets, tours, sectors and privacy zones
- H.264 Base/Main/High profiles and MJPEG encoding
- Web server configuration, operation and viewing
- Single Cat5e cable with PoE++
- Pendant, wall, pole and corner mounting bracket options

CohuHD Costar's 4220HD dome positioning system combines crystal clear HD image quality, bandwidth efficient H.264 compression, smooth variable speed positioning and IP67 protection delivering the CohuHD quality and performance you expect!

The 4220HD provides full 1080p imaging with 30x optical zoom, delivering full frame rate HD images over the entire zoom range for very cost effective long-range surveillance applications.

True day/night technology using a removable IR cut filter produces exceptional low light sensitivity down to 0.00025 fc.

For installations subject to wind or vibration, electronic image stabilization assures steady, clear images and enables the system designer to utilize existing bridge sign and traffic light poles for camera mounting.

The 4220HD includes defog/dehaze image processing, enhancing video performance in foggy and hazy conditions encountered in surveillance and traffic monitoring applications.

The 4220HD includes variable hi-speed pan and tilt drive, with 360° continuous pan and +5° to -90° tilt. Fast positioning speeds result in 180° movements in less than 1.5 seconds. The high-torque motor and gearing design, insures the positioner maintains position in high shock, vibration and hurricane force winds.

Providing multiple video stream profiles, the 4220HD delivers up to 5 or more independently configured H.264/MJPEG streams as well as analog video output with serial RS422 camera PTZ control.

Use of the IP and analog output allows integrating with analog systems today while providing a smooth transition to HD Video over IP tomorrow.

The 4220HD provides a full function web server, allowing complete administrative and operator control capabilities.

Administrative features include configuring network settings, user password assignments, setting video streaming properties, configuring camera imaging properties, defining presets and tours, and assigning camera ID labels.

The 4220HD is designed to operate in harsh weather with its IP67 enclosure protection. This eliminates the effects of water intrusion, pollutants and corrosives.

CohuHD delivers years of clean, reliable images and backs it with a world class three year warranty.
Series 4220HD
H.264 High-Definition, IP67 Dome Positioning System

DIMENSION INCHES (MM)

Secure with four 5/16" fasteners (not supplied) suitable for the mounting surface

End Cap

1.5" NPT pipe thread

Set Screw

Quick Disconnect top screws directly into mount

WALL MOUNTING DETAIL

Four 5/16" mounting studs (nuts and split lock washers supplied) for attaching the wall mount

End Cap

1.5" NPT pipe thread

Set Screw

Quick Disconnect top screws directly into mount

POLE MOUNTING DETAIL

Three stainless steel straps are supplied. Straps fit 3" (7.62 cm) to 8" (20.32 cm) diameter pole

Pole Mount 8518-2
(Also Includes 7411420-001 Wall Mount)

Wall Mount 7411420-001
## 2. DMS Model & Description

**Tampa Hillsborough Expressway Authority Systemwide Full Color OMS**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Model</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VF-2420-80x224-20-RGB</td>
<td>618-DE04, 618-DW06, 618-DW07, DT-C01, and MER-VS01 and MER-VS02 - Front Access OMS, Full Color, 20mm Pixel Pitch, 2 Lines using 18&quot; Characters; 3 Lines using 12&quot; Characters</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>VF-2420-64x320-20-RGB</td>
<td>618-VW03 Front Access OMS, Full Color, 20mm Pixel Pitch, 2 Lines using 18&quot; Characters; 3 Lines using 12&quot; Characters</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>UPS System</td>
<td>UPS (1 Hour Back-up) for 2/3 Line Front Access OMS. UPS Includes 1 Head Unit and 4 Batteries. To Be Mounted in Control Equipment Cabinet</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>VF-2420-48x128-20-RGB</td>
<td>618-VE04 &amp; Portable Replacement - Front Access OMS, Full Color, 20mm Pixel Pitch</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>UPS System</td>
<td>UPS (1 Hour Back-up) for 618-VE04 Front Access OMS. UPS Includes 1 Head Unit and 4 Batteries. To Be Mounted in Control Equipment Cabinet</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>VM-1020-32x160-20-RGB</td>
<td>BRN-N10 - Front Access OMS, Full Color, 20mm Pixel Pitch</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>UPS System</td>
<td>UPS (1 Hour Back-up) for BRN-N10 Front Access OMS. UPS Includes 1 Head Unit and 4 Batteries. To Be Mounted in Control Equipment Cabinet</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>VM-1020-24x288-20-RGB</td>
<td>34-C01, 301-C01, 78-C01, DT-C02, DT-C04, OT-COS, DT-N06 - Front Access OMS, Full Color, 20mm Pixel Pitch. Includes OMS Power and Control Equipment To Be Mounted in Control Equipment</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>UPS System</td>
<td>UPS (1 Hour Back-up) for DT-C02, DT-C04, OT-COS, DT-N06 Front Access OMS. UPS Includes 1 Head Unit and 2 Batteries. To Be Mounted in Control Equipment Cabinet</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>VM-1020-24x272-20-RGB</td>
<td>34-C01, 301-C01, 78-C01 Front Access OMS - Full Color, 20mm Pixel Pitch. Includes OMS Power and Control Equipment To Be Mounted in Control Equipment Cabinet</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Quantity</td>
<td>Notes</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
<td>-------</td>
</tr>
<tr>
<td>11</td>
<td>UPS System, UPS (1 Hour Back-up) for 34-C01, 301-C01, 78-C01 Front Access OMS. UPS includes 1 Head Unit and 2 Batteries. To be mounted in Control Equipment Cabinet.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>VM-1020-24x224-20-RGB, BRN-C04, BRN-C05, BRN-C06, BRN-C07 Front Access OMS - Full Color, 20mm Pixel Pitch. Includes OMS Power and Control Equipment To be mounted in Control Equipment Cabinet.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>VX-2428-32x48-20-RGB, BRN-C06, BRN-C07 Front Access OMS - Full Color, 20mm Pixel Pitch. Includes OMS Power and Control Equipment To be mounted in Control Equipment Cabinet. 2 Locations of 2 Panels per Site.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>UPS System, UPS (1 Hour Back-up) for BRN-C04, BRN-COS, BRN-C06, BRN-C07 Front Access OMS. UPS includes 1 Head Unit and 4 Batteries. To be mounted in Control Equipment Cabinet.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>VX-2428-32x48-20-RGB, OT-C03 Front Access OMS - Full Color, 20mm Pixel Pitch. Includes OMS Power and Control Equipment To be mounted in Control Equipment Cabinet. 1 Location of 3 Panels per Site.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>UPS System, UPS (1 Hour Back-up) for OT-C03 Front Access OMS. UPS includes 1 Head Unit and 4 Batteries. To be mounted in Control Equipment Cabinet.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>VM-1020-24x192-20-RGB, 34-C02, 301-C03, 78-C02 Front Access OMS - Full Color, 20mm Pixel Pitch. Includes OMS Power and Control Equipment To be mounted in Control Equipment Cabinet.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>UPS System, UPS (1 Hour Back-up) for 34-C02, 301-C03, 78-C02 Front Access OMS. UPS includes 1 Head Unit and 2 Batteries. To be mounted in Control Equipment Cabinet.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>VM-1020-16x192-20-RGB, BRN-N15 Front Access OMS - Full Color, 20mm Pixel Pitch. Includes OMS Power and Control Equipment To be mounted in Control Equipment Cabinet.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>UPS System, UPS (1 Hour Back-up) for BRN-N15 Front Access OMS. UPS includes 1 Head Unit and 2 Batteries. To be mounted in Control Equipment Cabinet</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>VM-1020-24x48-20-RGB, BRN-N13 &amp; BRN-N16 Front Access OMS - Full Color, 20mm Pixel Pitch. Includes OMS Power and Control Equipment To be mounted in Control Equipment Cabinet.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>UPS System</td>
<td>UPS (1 Hour Back-up) for BRN-N13 &amp; BRN-N16 Front Access OMS. UPS includes 1 Head Unit and 2 Batteries. To Be Mounted in Control Equipment Cabinet.</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>UPS System</td>
<td>UPS (1 Hour Back-up) for BRN-COB, BRN-N09, BRN-NC11, &amp; BRN-N14 Front Access OMS. UPS includes 1 Head Unit and 2 Batteries. To Be Mounted in Control Equipment Cabinet.</td>
<td></td>
</tr>
</tbody>
</table>
### VANGUARD® VF-2420-64x224-20-RGB

**Display Technology**  High-intensity LED  
**Cabinet Access**  Front access  
**Cabinet Enclosure**  NEMA 3R  
**Face Panel**  Aluminum mask over polycarbonate face panel  
**Dimensions**  5’8” x 16’6” x 1’4” (1.73 m x 5.03 m x .38 m)  
**Weight**  1030 lbs. (468 kg)  
**Operating Temp. Range**  -30˚ F to +165˚ F (-34˚ C to +74˚ C)  
**Humidity Range**  0 to 99%, non-condensing  
**Ventilation**  Pressurized, forced-air ventilation system  
**Controller Location**  Sign cabinet or equipment cabinet  
**Display Type**  Full-matrix (variable text and graphics)  
**Active Area**  4’3” x 15’2” (1.32 m x 4.62 m)  
**Top/Bottom Border Width**  8” (203 mm)  
**Left/Right Border Width**  8” (203 mm)  
**Pixel Matrix**  64 rows x 224 columns  
**Pixel Pitch**  20mm (.81”)  
**Viewing Distance**  300’ (91 m) using 6” characters  
**Sign Intensity**  12,400 candelas/m² minimum (white)  
**LED Color**  Full color (32,000 distinct colors using red, green and blue LEDs)  
**Power Requirements**  120/240 VAC, single-phase power (3-wires plus ground)  
**Communications Protocol**  NTCIP 1203 v02  
**Communications Options**  Cellular, fiber optic, direct Ethernet and radio Ethernet  
**Structural Design Standard**  AASHTO  
**NEMA Standards**  NEMA TS 4 Section 2 Environmental Requirements

### Power Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Viewing Angle (HxV)</th>
<th>Amps Per Leg</th>
<th>Typical Power</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VF-2420-64x224-20-RGB</td>
<td>30° x 30°</td>
<td>20</td>
<td>1486 W</td>
<td></td>
</tr>
</tbody>
</table>

### Sample Character Capacity

<table>
<thead>
<tr>
<th>Character Height</th>
<th>Lines/Characters</th>
<th>Example Font Size</th>
<th>Interline Spacing</th>
<th>Character Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>18”</td>
<td>2/12</td>
<td>23x15_3</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>12”</td>
<td>3/17</td>
<td>15x10_2</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>9”</td>
<td>3/22</td>
<td>12x8_2</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>6”</td>
<td>6/37</td>
<td>7x5_1</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

### NOTES

1. Display cabinet depth measurement includes “Z” mounting brackets on the rear of the cabinet.
2. Many other font sizes are available.
3. Amps per leg calculation is based on the maximum load of a typical DMS, including a fully-loaded 15A convenience outlet. This value is measured for a 120/240 3W+G system and will vary with auxiliary options installed in the DMS.
4. Typical power includes a partially-illuminated LED sign (38% of the pixels at full intensity), the sign controller and ventilation system.
5. Sign front face paint color is semi-gloss black. Other sides are mill finish aluminum.
6. With the continuous improvement of all Daktronics products, the features and measurements on this page are subject to change without notice.
7. The product illustration on this page is for conceptual purposes only and may not represent the actual dimensions of the specified display.
VANGUARD® VF-2420-64x320-20-RGB

**Power Specifications**

<table>
<thead>
<tr>
<th>Model</th>
<th>Viewing Angle (HxV)</th>
<th>Amps Per Leg</th>
<th>Typical Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>VF-2420-64x320-20-RGB</td>
<td>30° x 30°</td>
<td>28</td>
<td>2081 W</td>
</tr>
</tbody>
</table>

**Sample Character Capacity**

<table>
<thead>
<tr>
<th>Character Height</th>
<th>Lines/Characters</th>
<th>Example Font Size</th>
<th>Interline Spacing</th>
<th>Character Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>18”</td>
<td>2/17</td>
<td>23x15_3</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>12”</td>
<td>3/24</td>
<td>15x10_2</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>9”</td>
<td>3/32</td>
<td>12x8_2</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>6”</td>
<td>6/53</td>
<td>7x5_1</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

**Display Technology**
- High-intensity LED

**Cabinet Access**
- Front access

**Cabinet Enclosure**
- NEMA 3R

**Face Panel**
- Aluminum mask over polycarbonate face panel

**Dimensions**
- 5’8” x 23’0” x 1’4” (1.73 m x 7.01 m x .38 m)

**Operating Temp. Range**
- -30˚ F to +165˚ F (-34˚ C to +74˚ C)

**Humidity Range**
- 0 to 99%, non-condensing

**Ventilation**
- Pressurized, forced-air ventilation system

**Controller Location**
- Sign cabinet or equipment cabinet

**Display Type**
- Full-matrix (variable text and graphics)

**Active Area**
- 4’3” x 21’8” (1.32 m x 6.60 m)

**Top/Bottom Border Width**
- 8” (203 mm)

**Left/Right Border Width**
- 8” (203 mm)

**Pixel Matrix**
- 64 rows x 320 columns

**Pixel Pitch**
- 20mm (.81”)

**Viewing Distance**
- 300’ (91 m) using 6” characters

**Sign Intensity**
- 12,400 candelas/m² minimum (white)

**LED Color**
- Full color (32,000 distinct colors using red, green and blue LEDs)

**Power Requirements**
- 120/240 VAC, single-phase power (3-wires plus ground)

**Communications Protocol**
- NTCIP 1203 v02

**Communications Options**
- Cellular, fiber optic, direct Ethernet and radio Ethernet

**Structural Design Standard**
- AASHTO

**NEMA Standards**
- NEMA TS 4 Section 2 Environmental Requirements

---

**NOTES**

1. Display cabinet depth measurement includes “Z” mounting brackets on the rear of the cabinet.
2. Many other font sizes are available.
3. Amps per leg calculation is based on the maximum load of a typical DMS, including a fully-loaded 15A convenience outlet.
   - This value is measured for a 120/240 3W+G system and will vary with auxiliary options installed in the DMS.
4. Typical power includes a partially-illuminated LED sign (38% of the pixels at full intensity), the sign controller and ventilation system.
5. Sign front face paint color is semi-gloss black. Other sides are mill finish aluminum.
6. With the continuous improvement of all Daktronics products, the features and measurements on this page are subject to change without notice.
7. The product illustration on this page is for conceptual purposes only and may not represent the actual dimensions of the specified display.

117 Prince Drive, PO Box 5120, Brookings, SD 57006
tel 800-833-3157  605-692-0200 x57060  fax 605-697-4700
www.daktronics.com/its  email transportation@daktronics.com
Copyright © 2015 Daktronics  DD2349642  Rev05  060115
# VANGUARD® VM-1020-16x192-20-RGB

## Power Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th># of LED panels</th>
<th>Viewing Angle (HxV)</th>
<th>Amps Per Leg</th>
<th>Typical Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM-1020-16x192-20-RGB</td>
<td>1</td>
<td>30° x 30°</td>
<td>16</td>
<td>322 W</td>
</tr>
</tbody>
</table>

## Sample Character Capacity

<table>
<thead>
<tr>
<th>Character Height</th>
<th>Characters</th>
<th>Character Spacing</th>
<th>Example Font Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>9&quot;</td>
<td>1/19</td>
<td>2</td>
<td>12x8_2</td>
</tr>
<tr>
<td>12</td>
<td>1/14</td>
<td>3</td>
<td>15x10_2</td>
</tr>
</tbody>
</table>

## Notes

1. Typical power includes a partially-illuminated LED sign (38% of the pixels at full intensity) and the sign controller. For any other site configuration contact Daktronics.
2. VM-1020 Site Power Requirements include required 120/240 VAC 3-wires plus ground to equipment cabinet.
3. Sign front face paint color is semi-gloss black. Other sides are mill finish aluminum.
4. With the continuous improvement of all Daktronics products, the features and measurements on this page are subject to change without notice.
5. The product illustration on this page is for conceptual purposes only and may not represent the actual dimensions of the specified display.
6. 24VDC from equipment cabinet to sign required - see Daktronics riser diagram.
A DDMS set includes: 1 - 6 LED panel(s) and a DDMS cabinet

Multiple LED panels can be mounted to a single or multiple static panels

Multiple lines require multiple LED panels

LED panels are flexible in their ability to be aligned and oriented to static text on the static panel

Each LED panel employs a single line matrix

Max power cable run is 350’ from farthest LED panel to DDMS cabinet

All LED panels must be the same matrix width

Toll, travel time and status information can be intermixed and displayed on multiple LED panels within a set

**Optional Equipment**

**Mounting Kit**

For additional configuration options, contact Daktronics.
### VANGUARD® VM-1020-24x48-20-RGB

<table>
<thead>
<tr>
<th>Display Technology</th>
<th>High-intensity LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabinet Access</td>
<td>Front access</td>
</tr>
<tr>
<td>Cabinet Enclosure</td>
<td>NEMA 3R</td>
</tr>
<tr>
<td>Face Panel</td>
<td>Aluminum mask over polycarbonate face panel</td>
</tr>
<tr>
<td>Weight</td>
<td>84 lbs.</td>
</tr>
<tr>
<td>Dimensions</td>
<td>1'11&quot; x 3'7&quot; x 5&quot;</td>
</tr>
<tr>
<td>Operating Temp. Range</td>
<td>-30°F to +165°F (-34°C to +74°C)</td>
</tr>
<tr>
<td>Humidity Range</td>
<td>0 to 99%, non-condensing</td>
</tr>
<tr>
<td>Controller Location</td>
<td>Equipment cabinet</td>
</tr>
<tr>
<td>Display Type</td>
<td>Full-matrix (variable text and graphics)</td>
</tr>
<tr>
<td>Active Area</td>
<td>1'8&quot; x 3'4&quot;</td>
</tr>
<tr>
<td>Top/Sides Border Width</td>
<td>1.625&quot; (41 mm)</td>
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<tr>
<td>Bottom Border Width</td>
<td>1&quot; (26 mm)</td>
</tr>
<tr>
<td>Pixel Matrix</td>
<td>24 rows x 48 columns</td>
</tr>
<tr>
<td>Pixel Pitch</td>
<td>20mm (.81&quot;)</td>
</tr>
<tr>
<td>Viewing Distance</td>
<td>1100' using 18&quot; characters</td>
</tr>
<tr>
<td>Sign Intensity</td>
<td>12,400 candelas/m² minimum (white)</td>
</tr>
<tr>
<td>LED Color</td>
<td>Full color (32,000 distinct colors using red, green and blue LEDs)</td>
</tr>
<tr>
<td>Site Power Requirements</td>
<td>120/240 VAC, single-phase power (3-wires plus ground)</td>
</tr>
<tr>
<td>Sign Power Requirements</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Communications Protocol</td>
<td>NTCIP 1203 v02</td>
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<tr>
<td>Communications Options</td>
<td>Cellular, fiber optic, direct Ethernet and radio Ethernet</td>
</tr>
<tr>
<td>Structural Design Standard</td>
<td>AASHTO</td>
</tr>
<tr>
<td>NEMA Standards</td>
<td>NEMA TS 4 Section 2 Environmental Requirements</td>
</tr>
<tr>
<td>Critical Components</td>
<td>Located in equipment cabinet</td>
</tr>
</tbody>
</table>

### Power Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th># of LED panels</th>
<th>Viewing Angle (HxV)</th>
<th>Amps Per Leg</th>
<th>Typical Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM-1020-24x48-20-RGB</td>
<td>1</td>
<td>30° x 30°</td>
<td>16</td>
<td>220 W</td>
</tr>
</tbody>
</table>

### Sample Character Capacity

<table>
<thead>
<tr>
<th>Character Height</th>
<th>Characters</th>
<th>Character Spacing</th>
<th>Example Font Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>9&quot;</td>
<td>1/5</td>
<td>2</td>
<td>12x8_2</td>
</tr>
<tr>
<td>12</td>
<td>1/3</td>
<td>3</td>
<td>15x10_2</td>
</tr>
<tr>
<td>18</td>
<td>1/2</td>
<td>4</td>
<td>23x15_3</td>
</tr>
</tbody>
</table>

### NOTES

1. Typical power includes a partially-illuminated LED sign (38% of the pixels at full intensity) and the sign controller. For any other site configuration contact Daktronics.
2. VM-1020 Site Power Requirements include required 120/240 VAC 3-wires plus ground to equipment cabinet.
3. Sign front face paint color is semi-gloss black. Other sides are mill finish aluminum.
4. With the continuous improvement of all Daktronics products, the features and measurements on this page are subject to change without notice.
5. The product illustration on this page is for conceptual purposes only and may not represent the actual dimensions of the specified display.
6. 24VDC from equipment cabinet to sign required - see Daktronics riser diagram.
A DDMS set includes: 1 - 6 LED panel(s) and a DDMS cabinet

Multiple LED panels can be mounted to a single or multiple static panels

Multiple lines require multiple LED panels

LED panels are flexible in their ability to be aligned and oriented to static text on the static panel

Each LED panel employs a single line matrix

Max power cable run is 350' from farthest LED panel to DDMS cabinet

All LED panels must be the same matrix width

Toll, travel time and status information can be intermixed and displayed on multiple LED panels within a set

Optional Equipment

Mounting Kit

For additional configuration options, contact Daktronics.
VANGUARD® VM-1020-24x192-20-RGB

Full-Color (RGB)

Power Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th># of LED panels</th>
<th>Viewing Angle (HxV)</th>
<th>Amps Per Leg</th>
<th>Typical Power[^1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM-1020-24x192-20-RGB</td>
<td>1</td>
<td>30° x 30°</td>
<td>16</td>
<td>388 W</td>
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</table>

Sample Character Capacity

<table>
<thead>
<tr>
<th>Character Height</th>
<th>Characters</th>
<th>Character Spacing</th>
<th>Example Font Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>9&quot;</td>
<td>1/19</td>
<td>2</td>
<td>12x8_2</td>
</tr>
<tr>
<td>12</td>
<td>1/14</td>
<td>3</td>
<td>15x10_2</td>
</tr>
<tr>
<td>18</td>
<td>1/10</td>
<td>4</td>
<td>23x15_3</td>
</tr>
</tbody>
</table>

NOTES

1. Typical power includes a partially-illuminated LED sign (38% of the pixels at full intensity) and the sign controller. For any other site configuration contact Daktronics.
2. VM-1020 Site Power Requirements include required 120/240 VAC 3-wires plus ground to equipment cabinet.
3. Sign front face paint color is semi-gloss black. Other sides are mill finish aluminum.
4. With the continuous improvement of all Daktronics products, the features and measurements on this page are subject to change without notice.
5. The product illustration on this page is for conceptual purposes only and may not represent the actual dimensions of the specified display.
6. 24VDC from equipment cabinet to sign required - see Daktronics riser diagram.

Display Technology: High-intensity LED
Cabinet Access: Front access
Cabinet Enclosure: NEMA 3R
Face Panel: Aluminum mask over polycarbonate face panel
Weight: 232 lbs.
Dimensions: 1'11" x 13'4" x 5"
Operating Temp. Range: -30˚ F to +165˚ F (-34˚ C to +74˚ C)
Humidity Range: 0 to 99%, non-condensing
Controller Location: Equipment cabinet
Display Type: Full-matrix (variable text and graphics)
Active Area: 1'8" x 13'1"
Top/Sides Border Width: 1.625" (41 mm)
Bottom Border Width: 1" (26 mm)
Pixel Matrix: 24 rows x 192 columns
Pixel Pitch: 20mm (.81")
Viewing Distance: 1100' using 18" characters
Sign Intensity: 12,400 candelas/m² minimum (white)
LED Color: Full color (32,000 distinct colors using red, green and blue LEDs)
Site Power Requirements[^2]: 120/240 VAC, single-phase power (3-wires plus ground)
Sign Power Requirements[^5]: 24 VDC
Communications Protocol: NTCIP 1203 v02
Communications Options: Cellular, fiber optic, direct Ethernet and radio Ethernet
Structural Design Standard: AASHTO
NEMA Standards: NEMA TS 4 Section 2 Environmental Requirements
Critical Components: Located in equipment cabinet
A DDMS set includes: 1 - 6 LED panel(s) and a DDMS cabinet

- Multiple LED panels can be mounted to a single or multiple static panels
- Multiple lines require multiple LED panels
- LED panels are flexible in their ability to be aligned and oriented to static text on the static panel
- Each LED panel employs a single line matrix
- Max power cable run is 350’ from farthest LED panel to DDMS cabinet
- All LED panels must be the same matrix width
- Toll, travel time and status information can be intermixed and displayed on multiple LED panels within a set

Optional Equipment

Mounting Kit

For additional configuration options, contact Daktronics.
VANGUARD® VM-1020-24x224-20-RGB

Full-Color (RGB)

### Power Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th># of LED panels</th>
<th>Viewing Angle (HxV)</th>
<th>Amps Per Leg</th>
<th>Typical Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM-1020-24x224-20-RGB</td>
<td>1</td>
<td>30° x 30°</td>
<td>16</td>
<td>422 W</td>
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### Sample Character Capacity

<table>
<thead>
<tr>
<th>Character Height</th>
<th>Characters</th>
<th>Character Spacing</th>
<th>Example Font Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>9&quot;</td>
<td>1/22</td>
<td>2</td>
<td>12x8_2</td>
</tr>
<tr>
<td>12</td>
<td>1/17</td>
<td>3</td>
<td>15x10_2</td>
</tr>
<tr>
<td>18</td>
<td>1/12</td>
<td>4</td>
<td>23x15_3</td>
</tr>
</tbody>
</table>

### NOTES

1. Typical power includes a partially-illuminated LED sign (38% of the pixels at full intensity) and the sign controller. For any other site configuration contact Daktronics.
2. VM-1020 Site Power Requirements include required 120/240 VAC 3-wires plus ground to equipment cabinet.
3. Sign front face paint color is semi-gloss black. Other sides are mill finish aluminum.
4. With the continuous improvement of all Daktronics products, the features and measurements on this page are subject to change without notice.
5. The product illustration on this page is for conceptual purposes only and may not represent the actual dimensions of the specified display.
6. 24VDC from equipment cabinet to sign required - see Daktronics riser diagram.
A DDMS set includes: 1 - 6 LED panel(s) and a DDMS cabinet
- Multiple LED panels can be mounted to a single or multiple static panels
- Multiple lines require multiple LED panels
- LED panels are flexible in their ability to be aligned and oriented to static text on the static panel
- Each LED panel employs a single line matrix
- Max power cable run is 350’ from farthest LED panel to DDMS cabinet
- All LED panels must be the same matrix width
- Toll, travel time and status information can be intermixed and displayed on multiple LED panels within a set

Optional Equipment

Mounting Kit

For additional configuration options, contact Daktronics.
VANGUARD® VM-1020-24x288-20-RGB

**Power Specifications**

<table>
<thead>
<tr>
<th>Model</th>
<th># of LED panels</th>
<th>Viewing Angle (HxV)</th>
<th>Amps Per Leg</th>
<th>Typical Power¹</th>
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<tr>
<td>VM-1020-24x288-20-RGB</td>
<td>1</td>
<td>30° x 30°</td>
<td>16</td>
<td>501 W</td>
</tr>
</tbody>
</table>

**Sample Character Capacity**

<table>
<thead>
<tr>
<th>Character Height</th>
<th>Characters</th>
<th>Character Spacing</th>
<th>Example Font Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>9&quot;</td>
<td>1/29</td>
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<td>12x8_2</td>
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<tr>
<td>12</td>
<td>1/22</td>
<td>3</td>
<td>15x10_2</td>
</tr>
<tr>
<td>18</td>
<td>1/15</td>
<td>4</td>
<td>23x15_3</td>
</tr>
</tbody>
</table>

**Display Technology**
- High-intensity LED

**Cabinet Access**
- Front access

**Cabinet Enclosure**
- NEMA 3R

**Face Panel**
- Aluminum mask over polycarbonate face panel

**Weight**
- 330 lbs.

**Dimensions**
- 1'11" x 19'10" x 5"

**Operating Temp. Range**
- -30°F to +165°F (-34°C to +74°C)

**Humidity Range**
- 0 to 99%, non-condensing

**Controller Location**
- Equipment cabinet

**Display Type**
- Full-matrix (variable text and graphics)

**Active Area**
- 1'8" x 19'7"

**Top/Sides Border Width**
- 1.625" (41 mm)

**Bottom Border Width**
- 1" (26 mm)

**Pixel Matrix**
- 24 rows x 288 columns

**Pixel Pitch**
- 20mm (.81")

**Viewing Distance**
- 1100' using 18" characters

**Sign Intensity**
- 12,400 candelas/m² minimum (white)

**LED Color**
- Full color (32,000 distinct colors using red, green and blue LEDs)

**Site Power Requirements**²
- 120/240 VAC, single-phase power (3-wires plus ground)

**Sign Power Requirements**²
- 24 VDC

**Communications Protocol**
- NTCIP 1203 v02

**Communications Options**
- Cellular, fiber optic, direct Ethernet and radio Ethernet

**Structural Design Standard**
- AASHTO

**NEMA Standards**
- NEMA TS 4 Section 2 Environmental Requirements

**Critical Components**
- Located in equipment cabinet

**NOTES**

1. Typical power includes a partially-illuminated LED sign (38% of the pixels at full intensity) and the sign controller. For any other site configuration contact Daktronics.

2. VM-1020 Site Power Requirements include required 120/240 VAC 3-wires plus ground to equipment cabinet.

3. Sign front face paint color is semi-gloss black. Other sides are mill finish aluminum.

4. With the continuous improvement of all Daktronics products, the features and measurements on this page are subject to change without notice.

5. The product illustration on this page is for conceptual purposes only and may not represent the actual dimensions of the specified display.

6. 24VDC from equipment cabinet to sign required - see Daktronics riser diagram.
A DDMS set includes: 1 - 6 LED panel(s) and a DDMS cabinet

Multiple LED panels can be mounted to a single or multiple static panels

Multiple lines require multiple LED panels

LED panels are flexible in their ability to be aligned and oriented to static text on the static panel

Each LED panel employs a single line matrix

Max power cable run is 350’ from farthest LED panel to DDMS cabinet

All LED panels must be the same matrix width

Toll, travel time and status information can be intermixed and displayed on multiple LED panels within a set

Optional Equipment

Mounting Kit

For additional configuration options, contact Daktronics.
VANGUARD® VX-2428-32x48-20-RGB

**Full-Color (RGB)**

### Power Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Quantity</th>
<th>Viewing Angle [HxV]</th>
<th>Amps Per Leg</th>
<th>Typical Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>VX-2428-32x48-20-RGB</td>
<td>1</td>
<td>30° x 30°</td>
<td>16</td>
<td>268 W</td>
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<td>378 W</td>
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<td></td>
<td>3</td>
<td></td>
<td>16</td>
<td>488 W</td>
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<td></td>
<td>4</td>
<td></td>
<td>16</td>
<td>598 W</td>
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<td></td>
<td>16</td>
<td>710 W</td>
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<td></td>
<td>6</td>
<td></td>
<td>18</td>
<td>830 W</td>
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<td>7</td>
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<td>20</td>
<td>950 W</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td></td>
<td>22</td>
<td>1070 W</td>
</tr>
</tbody>
</table>

### Display Technology
- High-intensity LED

### Cabinet Access
- Front access

### Cabinet Enclosure
- NEMA 3R

### Face Panel
- Aluminum mask over polycarbonate face panel

### Weight
- 73 lbs. (34 kg)

### Dimensions
- 2’7” H x 3’6” W x 5” D (.73 m H x 1.1 m W x .13 m D)

### Operating Temp. Range
- -30° F to +165° F (-34˚ C to +74˚ C)

### Humidity Range
- 0 to 99%, non-condensing

### Controller Location
- Equipment cabinet

### Display Type
- Full-matrix (variable text and graphics)

### Active Area
- Equipment cabinet

### Top/Bottom Border Width
- 4” (101 mm)

### Left/Right Border Width
- 4” (101 mm)

### Pixel Matrix
- 32 rows x 48 columns

### Pixel Pitch
- 20mm (.81")

### Viewing Distance
- 300’ (91 m) using 6” characters

### Sign Intensity
- 12,400 candelas/m² minimum (white)

### LED Color
- Full color (32,000 distinct colors using red, green and blue LEDs)

### Site Power Requirements
- 120/240 VAC, single-phase power (3-wires plus ground)

### Sign Power Requirements
- 24 VDC

### Communications Protocol
- NTCIP 1203

### Communications Options
- Cellular, Serial, Ethernet

### Structural Design Standard
- AASHTO

### NEMA Standards
- NEMA TS 4 Section 2 Environmental Requirements

### Critical Components
- Located in equipment cabinet

### NOTES
1. Display cabinet depth measurement includes “Z” mounting brackets on the rear of the cabinet.
2. Many other font sizes are available.
3. Please contact Daktronics for site-specific power requirements.
4. Typical power includes a partially-illuminated LED sign (38% of the pixels at full intensity) and the sign controller.
5. VX-2428 Site Power Requirements include required 120/240 VAC 3-wires plus ground to equipment cabinet.
6. Sign front face paint color is semi-gloss black. Other sides are mill finish aluminum.
7. With the continuous improvement of all Daktronics products, the features and measurements on this page are subject to change without notice.
8. The product illustration on this page is for conceptual purposes only and may not represent the actual dimensions of the specified display.
9. 24VDC from equipment cabinet to sign required - see Daktronics riser diagram.

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daktronics.com/its  email transportation@daktronics.com
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The RuggedSwitch™ RS900G is an industrially hardened, fully managed Ethernet switch providing dual fiber optical Gigabit Ethernet ports and eight Fast Ethernet copper ports.

Designed to operate reliably in harsh industrial environments the RS900G provides a high level of immunity to electromagnetic interference and heavy electrical surges typical of environments found in electric utility substations, factory floors or in curb side traffic control cabinets. An operating temperature range of -40°C to +85°C coupled with hazardous location certification, optional conformal coating and a galvanized steel enclosure allows the RS900G to be placed in almost any location.

The embedded Rugged Operating System (ROS™) provides advanced networking features such as Enhanced Rapid Spanning Tree (eRSTP™), Port Rate Limiting and a full array of intelligent functionality for high network availability and manageability.

The versatility and wide selection of fiber optics allows the RS900G to be used in a variety of applications. The RS900G provides two fiber optical Gigabit Ethernet ports for creating a fiber optical backbone with high noise immunity and long haul connectivity.

**Ethernet Ports**
- 2 - Fiber Optical Gigabit Ethernet Ports (1000BaseX)
- 8 - Fast Ethernet Ports (10/100BaseTX)
- Multiple fiber connector types (LC, SC, SFP Pluggable Optics)
- Bi-directional singlestrand fiber support
- Long haul optics allow Gigabit distances up to 70km

**Cyber Security Features**
- Multi-level user passwords
- SSH/SSL encryption
- Enable/disable ports, MAC based port security
- Port based network access control (802.1x)
- VLAN (802.1q) to segregate and secure network traffic
- Radius centralized password management
- SNMPv3 encrypted authentication and access security

**RuggedRated™ for Reliability in Harsh Environments**
- Immunity to EMI and heavy electrical surges
  - Meets IEEE 1613 (electric utility substations)
  - Exceeds IEC 61850-3 (electric utility substations)
  - Exceeds IEEE 61800-3 (variable speed drive systems)
  - Exceeds IEC 61000-6-2 (generic industrial)
  - Exceeds NEMA TS-2 (traffic control equipment)
- Hazardous Location Certification: Class 1 Division 2
- -40 to +85°C operating temperature (no fans)
- Conformal coated printed circuit boards (optional)

**Rugged Operating System (ROS™) Features**
- Simple plug and play operation - automatic learning, negotiation, and crossover detection
- RSTP (802.1w) and Enhanced Rapid Spanning Tree (eRSTP™) network fault recovery (<5ms)
- Quality of Service (802.1p) for real-time traffic
- VLAN (802.1q) with double tagging and GVRP support
- Link aggregation (802.3ad)
- IGMP Snooping for multicast filtering
- Port Limiting and Broadcast Storm Limiting
- Port configuration, status, statistics, mirroring, security
- Industrial automation features (eg. Modbus)

**Management Tools**
- Web-based, Telnet, CLI management interfaces
- SNMP v1/v2/v3
- Remote Monitoring (RMON)
- Rich set of diagnostics with logging and alarms

**Universal Power Supply Options**
- Fully integrated power supply
- Universal high-voltage range: 88-300VDC or 85-264VAC
- Dual low-voltage DC inputs: 24VDC (9-36VDC) or 48VDC (36-59VDC)
- Terminal blocks for reliable maintenance free connections
- CSA/UL 60950 safety approved to +85°C
RuggedSwitch™ RS900G

10-Port Managed Ethernet Switch with Gigabit Uplink Ports

**Dual Gigabit Ports:**
- Pluggable Optics (SFP)
- LC or SC connectors
- Bi-directional (single strand)
- Distances up to 70km

**Integrated Power Supply**
- Universal high-voltage range: 88-300VDC or 85 - 264VAC
- Popular low voltage DC ranges: 24VDC (9-36VDC), 48VDC (36-59VDC)
- Dual Isolated DC power inputs

**Rugged Construction:**
- 20 AWG. galvanized steel enclosure
- Conformal coating (optional)

**Hazardous Location Certification**
- Class1, Division2

**Operating Temperature**
- -40°C to +85°C
- No Fans

**Fast Ethernet Ports:**
- 8 - Fast Ethernet Ports (10/100BaseTX)

**Mounting Options**
- Din Rail
- Panel Mount

**Critical Alarm Relay**
- Form-C failsafe contact relay: 1A@30VDC
Cyber Security
Cyber security is an urgent issue in many industries where advanced automation and communications networks play a crucial role in mission critical applications and where high reliability is of paramount importance. Key ROS™ features that address security issues at the local area network level include:

- **Passwords** - Multi-level user passwords secures switch against unauthorized configuration
- **SSH / SSL** - Extends capability of password protection to add encryption of passwords and data as they cross the network
- **Enable / Disable Ports** - Capability to disable ports so that traffic can not pass
- **802.1q VLAN** - Provides the ability to logically segregate traffic between predefined ports on switches
- **MAC Based Port Security** - The ability to secure ports on a switch so only specific Devices / MAC addresses can communicate via that port
- **802.1x Port Based Network Access Control** - The ability to lock down ports on a switch so that only authorized clients can communicate via this port
- **Radius** - Provides centralized password management
- **SNMPv3** - encrypted authentication and access security

The ROS™ cyber security features are included to help address the various industry specific security standards such as NERC CIP, ISA S99, AGA 12, IEC 62443, ISO 17799:2005 and PCSRF SPP-ICS.

Enhanced Rapid Spanning Tree Protocol (eRSTP™)
RuggedCom eRSTP allows the creation of fault-tolerant ring and mesh Ethernet networks that incorporate redundant links that are ‘pruned’ to prevent loops. eRSTP yields worst-case fault recovery¹ of 5ms times the ‘bridge diameter’ and allows rings of up to 80 switches. For example, a ring of ten switches will have fault recovery times under 50ms. eRSTP implements both STP and RSTP to ensure interoperability with commercial switches unlike other proprietary ‘ring’ solutions.

Quality of Service (IEEE 802.1p)
Some networking applications such as real-time control or VoIP (voice over IP) require predictable arrival times for Ethernet frames. Switches can introduce latency in times of heavy network traffic due to the internal queues that buffer frames and then transmit on a first come first serve basis. ROS™ supports ‘Class of Service’ in accordance with IEEE 802.1p that allows time critical traffic to jump ahead to the front of the queue thus minimizing latency and reducing jitter to allow such demanding applications to operate correctly. ROS™ allows priority classification by port, tags, MAC address, and IP type of service (TOS).

A configurable “weighted fair queuing” algorithm controls how frames are emptied from the queues.

VLAN (IEEE 802.1q)
Virtual local area networks (VLAN) allow the segregation of a physical network into separate logical networks with independent broadcast domains. A measure of security is provided since hosts can only access other hosts on the same VLAN and traffic storms are isolated. ROS™ supports 802.1q tagged Ethernet frames and VLAN trunks. Port based classification allows legacy devices to be assigned to the correct VLAN. GVRP support is also provided to simplify the configuration of the switches on the VLAN.

Link Aggregation (802.3ad)
The link aggregation feature provides the ability to aggregate several Ethernet ports into one logical link (port trunk) with higher bandwidth. This provides an inexpensive way to set up a high speed backbone to improve network bandwidth. This feature is also known as "port trunking", "port bundling", "port teaming", and "ethernet trunk".

IGMP Snooping
ROS uses IGMP snooping (Internet Group Management Protocol v1&v2) to intelligently forward or filter multicast traffic streams (e.g. MPEG video) to or from hosts on the network. This reduces the load on network trunks and prevents packets from being received on hosts that are not involved. ROS™ has a very powerful implementation of IGMP snooping that:

- Can be enabled on a per VLAN basis.
- Detects and filters all multicast streams regardless of whether subscribers exist.
- Supports "router-less" operation by supporting an "active" mode.
- Restores traffic streams immediately after an RSTP topology change.

SNMP (Simple Network Management Protocol)
SNMP provides a standardized method for network management stations the ability to interrogate devices from different vendors. SNMP versions supported by ROS™ are v1, v2c, and v3. SNMPv3 in particular provides security features (such as authentication, privacy, and access control) not present in earlier SNMP versions. ROS™ also supports numerous standard MIBs (Management Information Base) allowing for easy integration with any network management system (NMS).

¹ eRSTP fault recovery times may be approximated as follows:
   - For 100 Mbps, fault recovery performance is <5ms/hop
   - For 10,000 Mbps, fault recovery performance is <5ms/hop + 20ms
SNMP (Simple Network Management Protocol) (cont’d)
A feature of SNMP supported by ROS™ is the ability to generate “traps” upon system events. A NMS can record traps from multiple devices providing a powerful network troubleshooting tool. RuggedVue™ is RuggedCom's NMS that provides graphical visualization of the network and is fully integrated with all RuggedCom products.

SNTP (Simple Network Time Protocol)
SNTP automatically synchronizes the internal clock of all ROS™ devices on the network. This allows for correlation of time stamped events for troubleshooting.

SCADA and Industrial Automation
ROS™ contains features that optimize network performance and simplify switch management based on the unique requirements found in SCADA and industrial automation applications. Features such as Modbus TCP management for retrieval of switch data using the ubiquitous Modbus protocol and DHCP Option 82, a Rockwell Automation ODVA requirement for IP address assignment based on the location of the end device, provide capabilities not found in typical "commercial" or "office grade" Ethernet switches.

Port Based Network Access Control (802.1x)
ROS™ supports the IEEE 802.1x standard that defines a mechanism for port-based network access control which provides a means of authenticating and authorizing devices attached to LAN ports.

Port Rate Limiting
ROS™ supports configurable rate limiting per port to limit unicast and multicast traffic. This can be essential to managing precious network bandwidth for service providers. It also provides edge security for denial of service (DOS) attacks.

Broadcast Storm Filtering
Broadcast storms wreak havoc on a network and can cause attached devices to malfunction. This could be disastrous on a network with mission critical equipment. ROS™ limits this by filtering broadcast frames with a user-defined threshold.

Loss of Link Management
Some intelligent electronic devices (IEDs) have dual fiber optic ports with automatic failover to a backup port should the primary fail. ROS™ ensures this mechanism works reliably under all failure modes by appropriately disabling link signals when required. ROS™ also flushes learned MAC addresses to ensure the failover occurs quickly.

Port Mirroring
ROS™ can be configured to duplicate all traffic on one port to a designated mirror port. When combined with a network analyzer, this can be a powerful troubleshooting tool.

Port Configuration and Status
ROS™ allows individual ports to be 'hard' configured for speed, duplex, auto-negotiation, flow control and more. This allows proper connection with devices that do not negotiate or have unusual settings. Detailed status of ports with alarm and SNMP trap on link problems aid greatly in system troubleshooting.

Port Statistics and RMON (Remote Monitoring)
ROS™ provides continuously updating statistics per port that provide both ingress and egress packet and byte counters as well as detailed error figures. Also provided is full support for the RMON statistics, history, alarms, and event groups. RMON allows for very sophisticated data collection, analysis and detection of traffic patterns.

Event Logging and Alarms
ROS™ records all significant events to a non-volatile system log allowing forensic troubleshooting. Events include link failure and recovery, unauthorized access, broadcast storm detection, and self-test diagnostics among others. Alarms provide a snapshot of recent events that have yet to be acknowledged by the network administrator. An external hardware relay is de-energized during the presence of critical alarms allowing an external controller to react if desired.

HTML Web Browser and Telnet User Interfaces
ROS™ provides a simple, intuitive user interface for configuration and monitoring via a standard graphical web browser or via Telnet. All system parameters include detailed on-line help to make setup a breeze. ROS™ presents a common look and feel and standardized configuration process allowing easy migration to other RuggedCom managed products.

Configuration via ASCII Text File
All configuration parameters are stored in an ASCII formatted text file that can easily be transferred via TFTP or Xmodem. The configuration file can be saved for backup purposes and easily manipulated by a text editor. The same text file can be downloaded to the switch at a later date in order to re-configure or restore a previous configuration.

Command Line Interface (CLI)
A command line interface can be used in conjunction with remote shell to automate data retrieval, configuration updates, and firmware upgrades. A powerful SQL-like capability allows expert users the ability to selectively retrieve or manipulate any parameters the device has to offer.
## EMI and Environmental Type Tests

### IEC 61850-3 EMI TYPE TESTS

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Test Levels</th>
<th>Severity Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61000-4-2</td>
<td>ESD</td>
<td>Enclosure Contact +/- 8kV</td>
<td>4</td>
</tr>
<tr>
<td>IEC 61000-4-3</td>
<td>Radiated RFI</td>
<td>Enclosure ports 20 V/m</td>
<td>x</td>
</tr>
<tr>
<td>IEC 61000-4-4</td>
<td>Burst (Fast Transient)</td>
<td>Signal ports +/- 4k @ 2.5kHz</td>
<td>x</td>
</tr>
<tr>
<td>IEC 61000-4-5</td>
<td>Surge</td>
<td>D.C. Power ports +/- 2kV line-to-earth, +/- 1kV line-to-line</td>
<td>3</td>
</tr>
<tr>
<td>IEC 61000-4-6</td>
<td>Induced (Conducted) RFI</td>
<td>Signal ports 10V</td>
<td>3</td>
</tr>
<tr>
<td>IEC 61000-4-8</td>
<td>Magnetic Field</td>
<td>Enclosure ports 40 A/m continuous, 1000 A/m for 1 s</td>
<td>N/A</td>
</tr>
<tr>
<td>IEC 61000-4-29</td>
<td>Voltage Dips &amp; Interrupts</td>
<td>D.C. Power ports 30% for 0.1s, 60% for 0.1s, 100% for 0.05s</td>
<td>N/A</td>
</tr>
<tr>
<td>IEC 61000-4-11</td>
<td>Damped Oscillatory</td>
<td>Signal ports 2.5kV common, 1kV diff. mode@1MHz</td>
<td>3</td>
</tr>
<tr>
<td>IEC 61000-4-12</td>
<td>Mains Frequency Voltage</td>
<td>D.C. Power ports 30V Continuous, 300V for 1s</td>
<td>4</td>
</tr>
<tr>
<td>IEC 61000-4-16</td>
<td>Ripple on D.C. Power Supply</td>
<td>D.C. Power ports 10V</td>
<td>3</td>
</tr>
<tr>
<td>IEC 60255-5</td>
<td>Dielectric Strength</td>
<td>Signal ports 5kV (Fail-Safe Relay output)</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.3</td>
<td>ESD</td>
<td>Enclosure Contact +/- 8kV</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.2</td>
<td>Radiated RFI</td>
<td>Enclosure ports 35 V/m</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.1</td>
<td>Fast Transient</td>
<td>Signal ports +/- 4k @ 2.5kHz</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.1</td>
<td>Oscillatory</td>
<td>Signal ports 2.5kV common mode @1MHz</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90</td>
<td>H.V. Impulse</td>
<td>Signal ports 5kV (Fail-Safe Relay output)</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90</td>
<td>Dielectric Strength</td>
<td>Signal ports 2kVac</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### IEEE 1613 (C37.90.x) EMI IMMUNITY TYPE TESTS

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Test Levels</th>
<th>Severity Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE C37.90.3</td>
<td>ESD</td>
<td>Enclosure Contact +/- 8kV</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.2</td>
<td>Radiated RFI</td>
<td>Enclosure ports 35 V/m</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.1</td>
<td>Fast Transient</td>
<td>Signal ports +/- 4k @ 2.5kHz</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90.1</td>
<td>Oscillatory</td>
<td>Signal ports 2.5kV common mode @1MHz</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90</td>
<td>H.V. Impulse</td>
<td>Signal ports 5kV (Fail-Safe Relay output)</td>
<td>N/A</td>
</tr>
<tr>
<td>IEEE C37.90</td>
<td>Dielectric Strength</td>
<td>Signal ports 2kVac</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Environmental Type Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Test Levels</th>
<th>Severity Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60068-2-1</td>
<td>Cold Temperature</td>
<td>Test Ad</td>
<td>-40°C, 16 Hours</td>
</tr>
<tr>
<td>IEC 60068-2-2</td>
<td>Dry Heat</td>
<td>Test Bd</td>
<td>+85°C, 16 Hours</td>
</tr>
<tr>
<td>IEC 60068-2-30</td>
<td>Humidity (Damp Heat, Cyclic)</td>
<td>Test Db</td>
<td>95% (non-condensing), 55°C, 6 cycles</td>
</tr>
<tr>
<td>IEC 60255-21-1</td>
<td>Vibration</td>
<td>Tests Fc</td>
<td>2g @ (10 - 150) Hz</td>
</tr>
<tr>
<td>IEC 60255-21-2</td>
<td>Shock</td>
<td>Tests Ea</td>
<td>30g @ 11mS</td>
</tr>
</tbody>
</table>

Note: 1. Only applicable to functional earth connections separated from the safety earth connection.
2. Class 2 refers to "Measuring relays and protection equipment for which a very high security margin is required or where the vibration levels are very high, (e.g. shipboard application and for severe transportation conditions)"

www.RuggedCom.com
Technical Specifications

Power Supply
- Power Consumption: 10W Max
- 24VDC: 9-36 VDC, 0.4A
- 48VDC: 36-59 VDC, 0.2A
- Hi Voltage AC/DC: 88-300VDC or 85-264VAC

Critical Alarm Relay
- Form-C failsafe contact relay: 1A@30VDC

Physical
- Height: 7.4"
- Width: 2.6"
- Depth: 5.0"
- Weight: 2.7lbs
- Ingress Protection: IP40 (1mm objects)
- Enclosure: 20 AWG galvanized steel enclosure
- Mounting: DIN rail or panel mounted

Switch Properties
- Switching method: Store & Forward
- Switching latency: 7 us
- Switching bandwidth: 5.6Gbps
- MAC addresses: 4096
- MAC address table size: 32kbytes
- Priority Queues: 4
- Frame buffer memory: 2 Mbit
- VLANs: 4096
- IGMP multicast groups: 256
- Port rate limiting: 128kbps, 256, 512, 4, 8Mbps
- No head of line blocking

Approvals
- Hazardous Locations: Class 1, Division 2
- ISO: Designed and manufactured using a ISO9001: 2000 certified quality program
- CE Marking
- Emissions: FCC Part 15 (Class A), EN55022 (CISPR22 Class A)
- Safety: cCSAus (Compliant with CSA C22.2 No. 60950, UL 60950, EN60950)
- Laser Eye Safety (FDA/CDRH): Complies with 21 CFR Chapter1, Subchapter J.

Warranty
- 5 Years - Applicable to design and manufacturing related product defects.

Network Management
- HTTP graphical web-based
- SNMP v1, v2c, v3
- Telnet, VT100
- Command Line Interface (CLI)

EMI Immunity and Environmental Compliance
- IEC 61000-6-2 Industrial (Generic)
- IEC 61800-3 Industrial (Variable Speed Drive Systems)
- IEC 61850-3 Electric Utility Substations
- IEEE 1613 Electric Utility Substations
- NEMA TS 2 Traffic Control Equipment (pending)

IEEE Compliance
- 802.3-10BaseT
- 802.3u-100BaseTX, 100BaseFX
- 802.3x-Flow Control
- 802.3z-1000BaseLX
- 802.3ab-1000BaseTX
- 802.3ad-Link Aggregation
- 802.1d-MAC Bridges
- 802.1d-Spanning Tree Protocol
- 802.1p-Class of Service
- 802.1q-VLAN Tagging
- 802.1w-Rapid Spanning Tree Protocol
- 802.1x-Port Based Network Access Control

IETF RFC Compliance
- RFC768-UDP
- RFC783-TFTP
- RFC791-IP
- RFC792-ICMP
- RFC793-TCP
- RFC826-ARP
- RFC854-Telnet
- RFC894-IP over Ethernet
- RFC1112-IGMP v1
- RFC1519-CIDR
- RFC1541-DHCP (client)
- RFC1598-UDT
- RFC1907-SNMPv2-MIB
- RFC2012-TCP-MIB
- RFC2013-UDP-MIB
- RFC2015-IGMP v2
- RFC2236-IGMP v2
- RFC2284-EAP
- RFC2475-Differentiated Services
- RFC2865-Radius
- RFC3414-SNMPv3-VSM
- RFC3415-SNMPv3-VACM

IETF SNMP MIBS
- RFC1493-BRIDGE-MIB
- RFC1907-SNMPv2-MIB
- RFC2012-TCMIB
- RFC2013-UDP-MIB
- RFC2578-SNMPv2-SMI
- RFC2579-SNMPv2-TC
- RFC2819-RMON-MIB
- RFC2863-IF-MIB
- draft-ietf-bridge-rstpmib-03-BRIDGE-MIB
- draft-ietf-bridge-bridgemib-smiv2-03-RSTP-MIB
- IANAIfType-MIB
Fiber Specifications and Mechanical Drawing

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<tr>
<th>Parameter</th>
<th>Fiber Optical Specifications</th>
<th>Fiber Port Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>Multimode</td>
<td>Singlemode</td>
</tr>
<tr>
<td>Connector</td>
<td>LC, LC-SFP</td>
<td>SC, LC, LC-SFP</td>
</tr>
<tr>
<td>Typical Dist.</td>
<td>500m</td>
<td>10km</td>
</tr>
<tr>
<td>Optical Wavelength (nm)</td>
<td>850</td>
<td>1310</td>
</tr>
<tr>
<td>Cable Size/Cladding (um)</td>
<td>50/125 or 62.5/125</td>
<td>8/125 or 9/125</td>
</tr>
<tr>
<td>TX Power (Min/Max) (dBm)</td>
<td>-9.5/-4</td>
<td>-9/-3</td>
</tr>
<tr>
<td>RX Sensitivity (dBm)</td>
<td>-20</td>
<td>-22</td>
</tr>
<tr>
<td>RX Saturation (dBm)</td>
<td>0</td>
<td>-3</td>
</tr>
<tr>
<td>Typical Budget (dB)</td>
<td>14</td>
<td>17</td>
</tr>
</tbody>
</table>

Fiber Port Type:
- LC, LC-SFP
- SC, LC, LC-SFP
- LC-SFP

**Mechanical Drawing**

- Side mount panel brackets
- SFP connectors
- Dimensions: 5.186 x 4.590
- Height: 7.400
- Depth: 6.640
- Width: 2.564
RuggedSwitch™ RS900G
10-Port Managed Ethernet Switch with Gigabit Uplink Ports

Order Codes

RS900G -__ - __ - ______

PS   M    P9P10

PS: Power Supply
■ 24 = 24 VDC (9-36 VDC)
■ 48 = 48 VDC (36-59 VDC)
■ HI = 88-300VDC or 85-264VAC

M: Mounting Option
■ D = DIN Rail
■ P = Panel Mount
■ N = None

P9P10 Transceiver Options (2):
■ 2SFP = Dual 1000X SFP (Mini-GBIC). Order SFP Optics Separately.
■ 2LCMM = Dual 1000SX Multimode LC 850nm 500m
■ 2LC10 = Dual 1000LX Singlemode LC 1310nm 10km
■ 2LC25 = Dual 1000LX Singlemode LC 1310nm 25km
■ 2SC10 = Dual 1000LX Singlemode SC 1310nm 10km
■ 2SC25 = Dual 1000LX Singlemode SC 1310nm 25km

SFP (Mini-GBIC) Transceiver Options (1) (2):
■ 25-10-0111 = 1000SX SFP, Multimode, LC, 850nm, 500m (3)
■ 25-10-0100 = 1000LX SFP, Singlemode, LC, 1310nm, 10 km
■ 25-10-0101 = 1000LX SFP, Singlemode, LC, 1310nm, 25 km
■ 25-10-0109 = 1000LX SFP, Singlemode, LC, 1550nm, 70 km (3)

NOTES
1 Distance ratings are typical but will depend on type of cabling, number of connectors and splices.
2 Should you not find an appropriate fiber optic option listed here, please consult RuggedCom for other options.
3 These tranceivers have an operating temperature range of -20 to +85°C. All other tranceivers have an operating temperature range of -40° to +85°C.

Options

82-01-0002 - Conformal Coating

RuggedCom Inc.
30 Whitmore Road
Woodbridge, Ontario, Canada L4L 7Z4
Tel: (905) 856-5288 Fax: (905) 856-1995
Toll Free: (888) 264-0006
Technical Support Center: (866) 922-7975 or (954) 922-7975

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Ethernet is a trademark of the Xerox Corporation.
Patent Pending
All specifications in this document are subject to change without notice.
Rev 1-T

For additional information on our products and services, please visit our web site at: www.ruggedcom.com
5. Video Wall Specifications
ControlPoint server maintains complete display wall context, including defined sources and source objects, layout, keyboard shortcuts, and user login information resulting in a consistent presentation of information to all connected clients.

**ControlPoint Client**
ControlPoint client is the primary user interface used to manage a Jupiter display wall processor. ControlPoint client connects to the ControlPoint server over a local area network connection. ControlPoint client creates and manages windows displaying connected RGB and video sources, local and network applications, streaming video sources and saves display wall state in layout files for instant or scheduled recall.

**Intuitive and Informative Interface**
ControlPoint client presents an end user, upon successful login, with a mimic of the display wall complete with lines demarking the boundaries of individual display devices. All windows displayed on the wall, regardless of source, are present on the mimic in accurate proportion and placement. Mimic windows present near real time, scaled-down images of the actual display wall content, a feature unique to ControlPoint. This feature is extremely useful to determine if a window is correctly displaying content, what that content is, and to help users determine which window they are manipulating on large display walls. Mimic window content is configurable in both resolution and refresh rate. Windows of any type can be placed on the display wall with easy “point and click” operations. RGB input, video input, streaming video, and ControlPoint share windows can be created simply by drawing them on the mimic at the desired position and size, or by dragging the object from the object list onto the mimic. Local and network application windows can be created and placed by invoking the application directly from the ControlPoint client interface. Convenient display of web sites and web-based applications with custom frames and titling is possible with ControlPoints built-in web viewer object.

**ControlPoint Share**
ControlPoint share makes it possible to view and fully interact with any number of computers both on the Jupiter display wall and the ControlPoint remote client host system using only included software and a network connection. ControlPoint share window is cross-platform, allowing remote control between different types of computers: Windows desktops, Unix-based computers from companies such as Sun, HP and IBM, as well as Unix-based PCs. ControlPoint share windows displayed on a Jupiter display wall processor are fully scalable and can be placed anywhere on the wall. Direct control of the computer that is ControlPoint “shared” is as easy as selecting “Control This Window” from the ControlPoint client interface; a ControlPoint share window will be displayed on the client’s desktop for direct interaction and input.

**Complete Source Control**
Video, streaming video and RGB inputs that require special handling can be defined as a ControlPoint object easily selected into a ControlPoint window on the display wall processor. Once an application has been defined within ControlPoint as an application object, it can then be saved in layouts to be automatically executed and positioned at a future time, or invoked with a simple double-click of the mouse.

**Application Support**
ControlPoint supports executing and managing applications that are installed directly on the display wall processor. Once an application has been defined within ControlPoint as an application object, it can then be saved in layouts to be automatically executed and positioned at a future time, or invoked with a simple double-click of the mouse.

**System Monitoring**
Every Jupiter display wall processor has built-in software that monitors the status of critical components and internal environmental conditions. Fan tachometers, power supply voltages, CPU core and chassis ambient temperatures, as well as ECC memory errors are all monitored to ensure they are within normal operational parameters. ControlPoint client displays all monitored values in real time, providing a complete and timely view of the health of the display wall processor. In the event of a system component failing, or failing outside of normal operational parameters, the ControlPoint client displays a visual alarm alerting all connected users of the situation. A log message is also sent to each connected ControlPoint client and placed in the Windows log of the display wall processor. SNMP agents can use ControlPoint messages to provide integration with corporate network management systems. With accurate and timely information regarding required maintenance activity, repair and replacement, system work is no longer necessary and continuous availability of the display wall is assured.

**Configurability and Extensibility**
The ControlPoint protocol and supporting SDK can be used to construct custom applications and implement sophisticated control systems. An RS-232 gateway is provided for serial communication devices. Simple applications using JavaScript and HTML can be generated in minutes, whereas the complete power of a Jupiter display wall processor is available to those who truly want a customized interface and complete control.

**World Class Support**
Jupiter Systems is committed to continuous improvement of its software suite of applications, tools and APIs. Jupiter customers participating in extended software support can expect frequent software updates that make their existing purchase more functional, powerful and convenient to use.

**FOR MORE INFORMATION**
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Go to: www.jupiter.com
Email: info@jupiter.com

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ControlPoint™ — Complete and Effortless Control of Your Jupiter Display Wall
The HP 1910 switches are advanced smart managed fixed-configuration Gigabit Ethernet lite Layer 3 switches designed for small businesses looking for key enhanced features in an easy-to-administer solution. The series has five models: 16-, 24-, and 48-port 10/100/1000 non-PoE models; and two 24-port 10/100/1000 PoE models. All series switches have four additional true Gigabit Ethernet SFP ports for fiber connectivity. HP 1910 models support rack mounting or desktop operation and use variable-speed fans for quiet operation. The HP 1910 switches operate at full wirespeed, supporting QoS traffic prioritization and security features such as 802.1X network login, access control lists, and denial-of-service prevention. Customizable features include VLANs and link aggregation trunking as well as advanced features such as Layer 3 static routing and Spanning Tree Protocols (STP, RSTP, and MSTP). The HP 1910 switches come with a lifetime warranty covering the unit, fans, and power supplies.