

TECHNICAL SPECIAL PROVISION

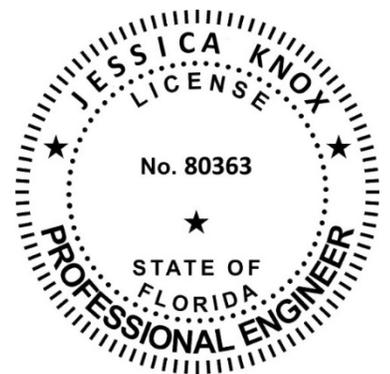
FOR

T612 - INTEGRATION AND TESTING

FINANCIAL PROJECT NO.: 445362-2-52-01; 440712-1-52-01

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T612
ITS/ATMS/CV DEVICE INTEGRATION AND TESTING

T612-1 General.

Perform ITS/ATMS/CV device integration and testing based on the construction project milestones and as required by these specifications, in accordance with the Contract Documents. Note that ITS/ATMS/CV includes all Connected Vehicle (CV) devices (i.e. SCMS-enabled RSUs, sensors - LiDAR, Camera and Radar) as well as ITS devices. The Department's/Maintaining Agency(s) current ITS/ATMS/CV device configuration settings, firmware versions, ATMS and SunGuide® configurations will be provided to the contractor by the Department, as applicable.

All equipment required for conducting tests must be supplied by the Contractor. The Contractor must provide qualified personnel to support the testing, diagnosis and repairing of system equipment. All test equipment used must have valid calibration certifications in accordance with the manufacturer's recommendations, notwithstanding modification required for integration. All devices shall be tested to determine conformance with the Project requirements, Department specifications and applicable Standards. All tests must be conducted with the manufacturer-supplied software and hardware, ATMS software and SunGuide® software as required.

The tests shall be conducted in the presence of a designated Department representative, unless otherwise approved in writing by the Department. The Department reserves the right to postpone any test for up to seven (7) days; such postponement shall not be grounds for extension of completion time. The Department may waive its right to witness certain tests.

Once the ITS/ATMS/CV devices are ready for testing, submit a written request to the Department's representative at least 14 calendar days prior to the proposed testing date. If the test is to be postponed due to an unsuccessful trial, the Department shall be given a minimum of two full business days prior notification before rescheduling. Perform and submit proof to the Department of a successful test with an original signature of the Department's Engineer on the test plan documents prior to the scheduled start of testing.

Failure of the ITS testing components to comply with the Project requirements, applicable standards, and Contract Documents for any test shall be counted as a defect, and the ITS or CV device under test shall be corrected or replaced. Any devices that fail more than twice shall be replaced.

No additional time extensions will be granted to perform the tests due to any failures as described herein. Correct all failures during the ITS testing at no additional cost to the Department.

Neither witnessing of the test(s) by the Department nor the waiving of the right to do so shall relieve the contractor of the responsibility to comply with the contract documents. Such actions by the Department or approval of any test results by the Department shall not be deemed as acceptance of the equipment or system tested until the successful completion of the 120-Calendar Day Operational Test Period.

Previously failed ITS or CV device functionality may be offered for re-test provided all

areas of non-compliance have been corrected and re-tested internally by the vendor, and evidence thereof is submitted and acceptable to the Department.

T612-2 ITS/ATMS/CV Device Testing Coordination.

Provide to the Department one device of each make/model requiring integration, 60 days prior to field implementation to allow the Department to review compatibility with SunGuide®. The 60-day requirement may be waived at the Department's discretion.

Whenever a device provided by the Contractor or the Department must change hands, a Handover Test must be conducted. The System Manager will conduct any Handover test on behalf of the Department for any owner-furnished equipment being provided to the Contractor. Likewise, the Contractor must conduct any Handover Test for Contractor furnished equipment being provided to the Department. The System Manager will provide the Department and Contractor with 14 calendar days' notice prior to performing a required Handover Test. This will apply to any Department-provided equipment or Contractor-provided equipment that the System Manager is responsible for configuring. The System Manager will test the device in the presence of the Contractor, or vice versa, to demonstrate that the device provided is in an operational state. Testing will be limited to the capabilities of the device within the testing environment. Upon successful completion of Handover Test, the Contractor or Department will take ownership of the equipment.

After all ITS/ATMS/CV devices of the same type are ready for testing, submit a written request to the Department's representative at least 14 calendar days prior to the proposed testing date. Conduct all tests in the presence of a Department representative. Testing must take place only on weekdays unless the Department allows the test to be conducted and/or continued on weekends and Department non-working days.

After all ITS/ATMS/CV devices within each sub-system satisfactorily pass the required tests, submit a PDF document of the completed test with the documented test results, including signatures, to the Department for review within 14 days following completion of the tests.

T612-3 ITS/ATMS/CV Device Integration.

ITS/ATMS/CV devices will be procured (as applicable), configured and integrated by the System Manager. Provide all configurable devices to the Department for configuration 60 days prior to installation in the field. The System Manager will take ownership of the devices after the Handover Test, to configure the ITS/ATMS/CV devices and return to the Contractor once configuration is complete. During the configuration period, the Contractor shall make available to the System Manger all required field support (i.e., field visits, hardware adjustments, device configurations, tools, etc.) for all ITS/ATMS/CV devices to ensure the ITS/ATMS/CV devices are successfully configured. Upon completion of the configurations, the System Manager will return ownership back to the Contractor via a Handover Test.

All ITS/ATMS/CV devices provided must use a version of the NTCIP protocol that is compatible with the existing SunGuide® software version. Ensure all ITS/ATMS/CV device protocols for each sub-system to be integrated with the SunGuide® Software are fully functional and compliant with the protocols listed online at: <http://sunguidesoftware.com/>. The use of translators and/or protocol converters are not allowed.

The Contractor will perform all firmware upgrades to all ITS/ATMS/CV contractor-furnished devices prior to providing to the Department or System Manager. Provide the master vendor software and configuration tools for all types of ITS/ATMS/CV devices installed in the Project to the Department with all applicable licensing.

The contract period will not be extended for time loss or delays related to testing. Any testing of the ITS/ATMS/CV components shall be considered part of the component's installation. No additional compensation will be made.

T612-4 ITS/ATMS/CV Device Field Acceptance Testing (FAT).

The Contractor will subject all ITS/ATMS/CV devices to a Field Acceptance Test (FAT) to demonstrate and document all stand-alone (non-network) functional operations of the ITS/ATMS/CV devices and ancillary components, including accuracy as required. Perform all FAT tests and record all FAT results utilizing the Department-approved testing procedures included in Exhibit A. If a test plan has not been provided, the Contractor shall develop a test plan. FAT tests are to be performed for each ITS/ATMS/CV device type installed which shall include the following, at minimum: Roadside Units (RSUs), Integrated V2I Prototype (IVP) Hubs, sensor devices (LiDAR and Camera), Wrong way driving systems (to include highlighted signs), Local Hub Ethernet Switch (LHES), Uninterruptable Power Supply (UPS), Remote Power Management Units (RPMU), Bluetooth Devices, Cellular Modems, Traffic Signal Controllers, MMUs, and Closed-Circuit Televisions (CCTVs).

All equipment required for completing the FAT shall be provided by the Contractor which shall include at minimum, two (2) dual-active or C-V2X SCMS-enabled On-Board Units (OBUs) and two (2) Human Machine Interfaces (HMIs) to be used for verifying and validating RSU and OBU data and communication during the Sub-system and System Acceptance Tests. The FAT must be completed prior to any device being connected to the network.

If any ITS/ATMS/CV/ CV device or ancillary component fails to pass the FAT more than twice, it must be replaced with a new ITS/ATMS/CV device or ancillary component of same make and model, and the entire FAT must be repeated until proven successful.

T612-5 120-Day Operational Test Period (OTP).

After successful completion of all required FAT tests for all sub-systems, subject all ITS/ATMS/CV Devices to a 120-Calendar Day Operational Test Period (OTP), during which time the Contractor must perform all maintenance activities required to maintain a fully functional ITS/ATMS/CV system, including troubleshooting, RMA, the initial site review if an issue is reported, and coordinating with the Contractor's Vendor for device related issues. The OTP will run simultaneously with the Sub-System Acceptance Test and the System Acceptance Test as described below.

The Contractor must notify the Department in writing of the scheduled start date of the OTP 14 calendar days prior to the commencement of the OTP. The OTP must not be performed without prior written approval from the Department.

If during the testing period a hardware or software related problem is discovered, the OTP will be halted. The Vendor must investigate and resolve the issue prior to continuing the OTP. The Department at its sole discretion may elect to restart the OTP test once the issue has

been determined based on the severity of the issue.

All software required for diagnosing malfunctions of hardware and software/firmware must be supplied to and approved by the Department prior to use. A copy of all diagnostic software must be submitted to the Department with full documentation within 14 days of deficiency resolution. Submit Failure Report Logs in demonstration that error rates are within requirements set herein.

The OTP steps described herein must be repeated as many times as deemed necessary by the Department to satisfy the requirements of these Technical Special Provisions. The Contractor will not be granted time extensions to perform the OTP due to any failures as described herein. Correct any and all failures required to resume the OTP at no additional cost to the Department.

T612-6 ITS Device Sub-System Acceptance Testing (S-SAT).

The Contractor will be responsible for conducting the sub-system test for the following devices: Wrong Way Driving (WWD) and LiDAR system.

The System Manager shall be responsible for S-SAT testing for the remaining devices during the 120-day operational test period after the completion of the project.

T612-7 ITS Device System Acceptance Testing (SAT).

The Contractor will be responsible for conducting the system test for the following devices: Wrong Way Driving (WWD) and LiDAR system.

The System Manager shall be responsible for SAT testing for the remaining devices during the 120-day operational test period after the completion of the project.

T612-8 Physical Site and Network Access.

Complete any and all required security access request forms formally requesting security clearance for physical site and network access to secure Department ITS/ATMS/CV hubs and networks. Site and network access will be required for all contractor and subcontractor personnel that need access to existing ITS/ATMS/CV hubs and/or the ITS/ATMS/CV network for construction and testing, or other purposes. It is the contractor's responsibility to complete and submit the required security access request forms no less than 45 calendar days prior to needing access. The 45-calendar day security access request review period is required for Department review and related background security checks. The Department reserves at its sole discretion to grant or deny access to any software, hardware, site, etc.

T612-9 Method of Measurement

The quantity to be paid for will be based on the number of devices furnished and/or installed, tested, and accepted.

T612-10 Basis of Payment.

Price and payment for all work specified in this Technical Special Provision will be incidental to the ITS/ATMS/CV device pay items for which the testing is required.

No additional payment will be made.

Exhibit A Field Acceptance Test Procedures (FAT)

Utilize the following Department approved ITS/ATMS/CV device FAT testing procedures. If a device is not identified below, develop a FAT for that device for Engineer approval.

Exhibit A Section – 1 Managed Field Ethernet Switch (MFES)

Exhibit A Section – 2 Uninterruptible Power Supply (UPS)

Exhibit A Section – 3 Closed Circuit Television (CCTV) Camera

Exhibit A Section – 4 IVP Hub/In-Cabinet Processor & Sensors (LiDAR and Camera)

Exhibit A Section – 5 Roadside Unit (RSU)

Exhibit A Section – 6 Bluetooth (BT) Device

Exhibit A Section – 7 Remote Power Management Unit (RPMU)

Exhibit A Section – 8 Wrong Way Driving (WWD)

1. Managed Field Ethernet Switch (MFES)

Field Acceptance Test (FAT)

MFES Device Name: _____ Local Hub: _____ Station: _____
 MFES Voltage Reading: _____
 Product Manufacturer's Name: _____
 Product Make: _____
 Product Model: _____
 Product Serial Number: _____
 Product Firmware Version Number: _____
 Product IP Address: _____
 Product Gateway: _____
 Product Subnet Mask: _____

Local Hub Number: _____ Location: _____			
IP: _____ MAC Address _____			
Step Number	Procedure	Expected Results	Results/Comments
1	Conduct visual/electrical safety inspection.	No cut cable jackets or exposed electrical wiring.	Pass _____ Fail _____
2	Ensure that all wiring complies with NEC requirements, standards and are in accordance with project plans. The details in the back of the plans may be different from job to job and could be specific.	Equipment construction was completed per contract documents.	Pass _____ Fail _____
3	Verify all connections, including correct installation of communication and power cables.	Equipment is connected to the MFES. LHUB devices and power connections to the MFES are correct.	Pass _____ Fail _____
4	Verify Device Voltage is within operating voltage VAC.	Record the voltage levels VAC _____ VDC _____	Pass _____ Fail _____
5	Verify CLI (Command Line Interface, Serial) and GUI (Graphic User Interface, Ethernet) are responding through Serial and Ethernet ports.	Utilize the Laptop to communicate to the device. Communication should be established.	Pass _____ Fail _____
6	Verify System Identification Information matches approved scheme		Pass _____ Fail _____
7	Verify that standard port assignment convention is	Equipment configured per contract documents.	Pass _____ Fail _____

Local Hub Number: _____ Location: _____			
IP: _____ MAC Address _____			
Step Number	Procedure	Expected Results	Results/Comments
	followed and all ports are labeled per the project documents.		
8	Verify MFES IP Address, Gateway, and Subnet Mask Match Approved IP List (Yes/No).	IP Address: _____ Gateway: _____ Subnet Mask: _____	Pass _____ Fail _____
9	Verify firmware is correct	Firmware is at the latest edition according to the Vendor's website.	Pass _____ Fail _____
10	Verify that correct VLAN's have been configured as directed by and coordinated with the agency.	All necessary VLAN's will be present in the MFES configuration.	Pass _____ Fail _____
11	Verify communication to each device directly connected to MFES by initiating a ping.	The laptop will verify IP communications by sending <i>ICMP</i> echo request packets to the MFES and laptop will verify an <i>ICMP</i> response.	Pass _____ Fail _____

Exhibit A Section 2

2. Uninterruptible Power Supplies (UPS)

Field Acceptance Test (FAT)

UPS Device Name: _____ Local Hub: _____ Station: _____
 UPS Voltage Reading: _____
 Product Manufacturer's Name: _____
 Product Make: _____
 Product Model: _____
 Product Serial Number: _____
 Product Firmware Version Number: _____
 Product IP Address: _____
 Product Gateway: _____
 Product Subnet Mask: _____

Local Hub Number: _____ Location: _____ MAC Address _____			
Step Number	Procedure	Expected Results	Results/Comments
1	Verify UPS is installed per the plans and in compliance with the NEC and proper labeling of devices, system components, and cables.	Check the plans to verify equipment is installed per plans.	Pass _____ Fail _____
2	Verify all LED lights on the front panel interface are operational and that all devices have been connected to the UPS.	Visually inspect the LED lights on the unit to verify all LEDs are operational.	Pass _____ Fail _____
3	Verify proper voltage in VAC _____ is provided from each output port.	Record the voltage levels VAC _____ VDC	Pass _____ Fail _____
4	Perform Self-Test on the UPS and verify there are no errors reported.	Check the UPS logs to verify no errors.	Pass _____ Fail _____
5	Verify that UPS is accessible through the web interface via Ethernet connection.	Use the laptop to ping the UPS IP address.	Pass _____ Fail _____
6	Verify UPS IP Address, Gateway, and Subnet Mask Match Approved IP List (Yes/No).	IP Address: _____ Gateway: _____ Subnet Mask: _____	Pass _____ Fail _____
7	Verify that UPS has been configured with proper location name and system information.	GUI interface via web browser will reflect proper location information.	Pass _____ Fail _____
8	Verify with a digital multi-meter the voltage of UPS batteries and compare with UPS display of	Bat.#1: _____ Bat.#2: _____ Bat.#3: _____ Bat.#4: _____	Pass _____ Fail _____

Local Hub Number: _____ Location: _____ MAC Address _____			
Step Number	Procedure	Expected Results	Results/Comments
	battery voltage.		
9	Verify proper voltage continues through output ports following disconnection from constant power source.		Pass _____ Fail _____
10	Check the Event Log after the power is restored and record time of failure.	Actual Time in Hours/Minutes:	Pass _____ Fail _____
11	Turn off commercial power breaker in cabinet and verify that UPS power supports the functionality of all devices without power feed interruption. UPS power shall support the connected load for a minimum of 2 hours.	Actual Time in Hours/Minutes:	Pass _____ Fail _____

3. Closed Circuit Television (CCTV) Cameras

Field Acceptance Test (FAT)

CCTV Name: _____ Local Hub: _____ Station: _____
 CCTV Voltage Reading: _____
 Product Manufacturer's Name: _____
 Product Make: _____
 Product Model: _____
 Product Serial Number: _____
 Product Firmware Version Number: _____
 Product IP Address: _____
 Product Gateway: _____
 Product Subnet Mask: _____

Local Hub Number: _____ Camera Number: _____ Camera Serial #: _____ Location: _____ IP: _____ MAC Address _____			
Step Number	Procedure	Expected Results	Results/Comments
1	Conduct visual/electrical safety inspection.	No cut cable jackets or exposed electrical wiring.	Pass _____ Fail _____
2	Verify all cabinet and device wiring connections.	Connections verified.	Pass _____ Fail _____
3	Verify the quality and tightness of ground and surge protection connections.	Connections verified.	Pass _____ Fail _____
4	Verify proper labeling of devices, system components, and cables.	All devices, components and cables are labeled.	Pass _____ Fail _____
5	"Power on" the control cabinet and verify proper voltages for all power supplies and related power circuits.	Confirm 115 VAC power is supplied to the cabinet and proper voltage is supplied to all power circuits and supplies.	Record voltage _____ VAC
6	Switch the circuit breakers to on position.	Cabinet light and fan operational.	Pass _____ Fail _____
7	"Power on" all devices and peripheral components.	Device power is on.	Pass _____ Fail _____
8	"Power on" laptop computer, run control software.	Laptop operational, control software ready.	Pass _____ Fail _____

Local Hub Number: _____ Camera Number: _____ Camera Serial #: _____
 Location: _____ IP: _____ MAC Address _____

Step Number	Procedure	Expected Results	Results/Comments
9	Connect a laptop computer to the Network port on the POE Injector (on the camera side of the lightning protection box).	With power applied to the laptop, there should be an image from the camera on the computer.	Pass _____ Fail _____
10	Select the ZOOM Out command and hold in down until the camera has zoomed to wide angle.	The image on the monitor is clear, detailed, and usable video images of the areas, object, and other subjects visible from a roadside CCTV Camera field site. Ensure that video produced by the camera is true, accurate, distortion free, and free from transfer smear, oversaturation, and any other image defect that negatively impacts image quality under all lighting and weather conditions in both color and monochrome modes. (If it is already not zoomed out as far as it can go).	Pass _____ Fail _____
11	Select the PAN Left command, and then select PAN Stop after one 360° rotation.	The camera completes the command.	Pass _____ Fail _____
12	Select the PAN Right command, and then select PAN Stop after one 360° rotation.	The camera completes the command.	Pass _____ Fail _____
13	Select the TILT Up command.	The camera completes the command, reaching the upper limit of the dome.	Pass _____ Fail _____
14	Select the TILT Down command.	The camera completes the command, pointing directly to the ground below the camera.	Pass _____ Fail _____

Local Hub Number: _____ Camera Number: _____ Camera Serial #: _____
 Location: _____ IP: _____ MAC Address _____

Step Number	Procedure	Expected Results	Results/Comments
15	Select TILT Up or Down, then TILT Stop.	The camera completes the command.	Pass _____ Fail _____
16	Using the PAN/TILT commands, position the camera to view an object (a sign makes a good target) that is 100 ft to 200 ft from the camera. Select the ZOOM In command and hold down until the camera has zoomed to telephoto.	The object grows larger on the monitor and the image remains focused when testing a camera in the daytime.	Pass _____ Fail _____
17	Re-adjust the camera position using the PAN/TILT commands to keep the selected object in the center of the monitor. Select the FOCUS Near command.	The image on the monitor should go out of focus.	Pass _____ Fail _____
18	Select the FOCUS Far command.	The image on the monitor should return to focus and then go out of focus again.	Pass _____ Fail _____
19	Select the Auto FOCUS command.	The image on the monitor should return to focus.	Pass _____ Fail _____
20	Select the ZOOM Out command and hold in down until the camera has zoomed to wide angle.	The image will lose some detail, but it should stay in focus.	Pass _____ Fail _____
21	Select the IRIS Open command.	The image on the monitor turns bright.	Pass _____ Fail _____
22	Select the IRIS Close command.	The image on the monitor turns dark.	Pass _____ Fail _____
23	Select the Man IRIS command (returning the iris to auto).	The camera should return to a normal image.	Pass _____ Fail _____

Local Hub Number: _____ Camera Number: _____ Camera Serial #: _____
 Location: _____ IP: _____ MAC Address _____

Step Number	Procedure	Expected Results	Results/Comments
24	Configure preset 1 to view image of roadway directly in front of CCTV site. Using S/W instruct CCTV to move to preset 1.	CCTV moves to preset 1 and views roadway directly in front of CCTV site.	Pass _____ Fail _____
25	Configure preset 2 to view roadway to the northbound limit of the roadway. Using S/W instruct CCTV to move to preset 2.	CCTV moves to preset 2 and views roadway to the north of the CCTV site.	Pass _____ Fail _____
26	User shall remove the CCTV pole cover and install the CCTV lowering device wench to pole and attach clevis to lowering device cable.	Cable lowering device wench is tightly connected to pole and lowering device cable.	Pass _____ Fail _____
27	User shall lower camera to the wench location using either the manual wench or using the manufacturers supplied drill.	CCTV lowers smoothly to user at pole location.	Pass _____ Fail _____
28	User shall raise camera to the original location using either the manual wench or using the manufacturers supplied drill and Camera will lock into place and all slack shall be removed from lowering devices cable. Cover will be reinstalled.	CCTV rises smoothly to the original pole location. Camera locks in place and cable is secured in pole. Cover is securely attached to the CCTV Pole.	Pass _____ Fail _____
29	User shall verify video and PTZ control to ensure camera is powered on, displaying video, and can be manipulated by user.	CCTV will be in same operational condition before the lowering of the CCTV Camera.	Pass _____ Fail _____
30	Remove power from camera to reboot camera. Once restored, verify network settings, PTZ presets, and camera titling are saved.	CCTV camera will retain all custom configurations previously entered.	Pass _____ Fail _____

Local Hub Number: _____ Camera Number: _____ Camera Serial #: _____
 Location: _____ IP: _____ MAC Address _____

Step Number	Procedure	Expected Results	Results/Comments
31	Night-Time Test Procedure: Operator at the TMC turns on CCTV to verify that the image is clear at night.	Operator confirms that the image is clear and provides a screenshot picture.	Pass _____ Fail _____

4. IVP Hub/In-Cabinet Processor & Sensors (LiDAR and Camera)

Field Acceptance Test (FAT)

System Equipment Name: _____ Local Hub: _____ Station: _____
 System Equipment Name Voltage Reading: _____
 Product Manufacturer's Name: _____
 Product Make: _____
 Product Model: _____
 Product Serial Number: _____
 Product Firmware Version Number: _____
 Product IP Address: _____
 Product Gateway: _____
 Product Subnet Mask: _____

LHUB: _____ IVP Hub SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
1	Ensure all In-cabinet processors are installed in accordance with the contract documents, manufacturers recommendations, and as directed by the Engineer.	In-Cabinet Processors are installed per the plans and specifications.	Pass ___ Fail ___
2	Verify that physical construction, device connections to power sources, installation of cables and connections between all devices and the cabinet has been completed per the plans and specifications.	Physical construction, device connections, and installation of cables are installed per the plans and specifications.	Pass ___ Fail ___
3	Verify the quality and tightness of ground and surge protection connections.	Connections verified.	Pass ___ Fail ___
4	Verify that the IVP Hub is accessible through a web interface.	Access to the IVP Hub and GUI from the web.	Pass ___ Fail ___
5	Verify manufacturer-recommended power and voltage to sensors (LiDAR and Camera). This will ensure that there is no data loss during data transfer.	Power/Voltage supply per manufacturer recommendation per meter readings.	Pass ___ Fail ___
6	Verify that the IVP Hub can communicate with the sensors and are correctly configured for detection zones.	Communication is established using vendor software allowing configurability.	Pass ___ Fail ___

LHUB: _____ IVP Hub SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
7	Verify access to the sensors for configuration of the CV applications.	IVP Hub/In-cabinet processor reaches the sensors for configuration.	Pass ___ Fail ___
8	Verify IVP Hub communication with the RSU for RSU broadcasting as “immediate forward”.	IVP Hub integrates the RSU to facilitate “immediate forward” of CV messages for broadcasting.	Pass ___ Fail ___
9	Verify that the IVP Hub is configured to activate the Highlighted Signs automatically for WWD and/or Pedestrian Safety Applications.	Activation of highlighted signs are active based on pre-defined settings.	Pass ___ Fail ___
10	Verify that software licenses needed to operate the Connected Vehicle applications have been obtained, and that the software is installed and operational on the IP Hub/In-cabinet processor .	All licenses are accounted for.	Pass ___ Fail ___

****Camera to be tested under CCTV Exhibit A Section 3.**

Exhibit A Section 5

5. Roadside Unit (RSU)

Field Acceptance Test (FAT)

RSU Name: _____ Local Hub: _____ Station: _____
 RSU Voltage Reading: _____
 Product Manufacturer's Name: _____
 Product Make: _____
 Product Model: _____
 Product Serial Number: _____
 Product Firmware Version Number: _____
 Product IP Address: _____
 Product Gateway: _____
 Product Subnet Mask: _____

LHUB: _____ RSU SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
1	Ensure all RSU are installed in accordance with the contract documents, manufacturers recommendations, and as directed by the Engineer.	RSU's are installed per the plans and specifications.	Pass ___ Fail ___
2	Ensure all DSRC and C-V2X Antennas, GPS Antennas, and B/T Antennas are installed per manufacturers documentation.	All Antennas are installed per manufacturers documentation.	Pass ___ Fail ___
3	Verify RSU has appropriate FCC Licensing, documentation, and is clearly marked on the RSU with an FCC Sticker.	RSU is licensed by the FCC with the supporting documentation and is clearly marked on the unit.	Pass ___ Fail ___
4	Ensure surge protection of the Omni Directional C-V2X Antennas as well as the GPS Antennas in accordance with contract documents and Section 620.	Omni Directional and GPS Antennas are properly grounded per contract documents and Section 620.	Pass ___ Fail ___
5	Inspect the quality and tightness of ground and surge protector connections.	All connections are properly secured and tightened.	Pass ___ Fail ___
6	Verify all connections, including correct installation of	All connections are correct.	Pass ___ Fail ___

LHUB: _____ RSU SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
	communication and power cables.		
7	Verify the SPD is installed, wired correctly, and grounded in the cabinet/LHUB per plan details.	SPD is installed correctly and grounded in the cabinet/LHUB.	Pass ___ Fail ___
8	Verify Power over Ethernet Injector (PoE) has been installed correctly per the plan details in the cabinet/LHUB.	Power over Ethernet Injector (PoE) has been installed per plan details.	Pass ___ Fail ___
9	Verify the input of the Power over Ethernet Injector (PoE) is 120VAC and the output is 48VDC.	Input of the PoE _____ Output of the PoE _____	Pass ___ Fail ___
10	Power up the RSU by plugging in the POE Ethernet Cable to the appropriate LAN Port.	Indicator lights up "Green"	Pass ___ Fail ___
11	Establish communication with the RSU by using a laptop and either ping the device through a Secured Shell or Graphical User Interface (GUI).	Communication has been established with the unit. RSU responds with a ping reply.	Pass ___ Fail ___
12	Through the Graphical User Interface (GUI) ensure all network interfaces are configured correctly, based on the approved FDOT IP Schema, with the proper IPs.	Network interfaces are correctly configured based on the approved FDOT IP Schema.	Pass ___ Fail ___
13	Through the Graphical User Interface (GUI) ensure all device configurations, installed by the Contractor, are properly configured per location.	RSU is properly configured per location.	Pass ___ Fail ___
14	Verify through the Graphical User Interface (GUI) that the appropriate MAP and TIM Messages are installed in "Store and Repeat" Mode if broadcasted	RSU has the proper messages and is programmed for "Store and Repeat"	Pass ___ Fail ___

LHUB: _____ RSU SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
	CV messages are not dynamic. This setting is location-specific.		
15	Ensure the correct MAP Message has been installed per location and has been verified accurate.	MAP message has been installed and is verified for accuracy.	Pass ___ Fail ___
16	Where applicable, verify all configurations are correct for receiving SPaT stream from the traffic signal controller.	Configurations are accurate to receive SPaT stream.	Pass ___ Fail ___
17	Using an OBU and HMI, verify all J2735 messages are being broadcasted by the RSU.	Receiving all J2735 messages being broadcasted by the RSU.	Pass ___ Fail ___
18	Verify that the RSUs are pre-configured and enrolled with ISS GreenHills SCMS Certificates for signed and secured message.	Security Certificates are being broadcasted by the RSU and verified on the RSUs GUI.	Pass ___ Fail ___
19	Verify that all RSUs can be reached and configured for TIM broadcasting by the SunGuide Software at the RTMC for Immediate Forward and/or Store and Repeat where applicable.	Increasing counters for TIM "sent" depicted on the RSU GUI as well as on the SunGuide interface. <i>(Note: this will be later verified during field testing with the OBU and HMI)</i>	Pass ___ Fail ___

5. Roadside Unit (RSU) (Continued)

Field Acceptance Test Witness Signatures

Technician Name: _____ Technician Signature: _____

Date: _____ Device Serial Number: _____

Test Start Time: _____ Test Finish Time: _____

Test anomalies and comments (if applicable) _____

Department Rep. Name: _____ Department Rep. Signature: _____

6. BlueTooth Device

Field Acceptance Test (FAT)

BlueTooth Name: _____ **Local Hub:** _____ **Station:** _____
BlueTooth Voltage Reading: _____
Product Manufacturer's Name: _____
Product Make: _____
Product Model: _____
Product Serial Number: _____
Product Firmware Version Number: _____
Product IP Address: _____
Product Gateway: _____
Product Subnet Mask: _____

LHUB: _____ BLUETOOTH READER SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
1	Confirm BT Antenna is properly connected to the Reader.	Antenna cable should be firmly connected to reader.	Pass ___ Fail ___
2	Confirm BT Antenna Alignment & Height. Confirm the Bluetooth Pole and Reader are installed per the plans and specifications. Confirm the Bluetooth Antenna is installed according to the ITS plan set and manufacturer's recommended height. The Technician shall verify there is a clear pathway for the Antenna to see across all travel lanes, as applicable to the directions of travel being observed (i.e. median clearing, elevated highway, etc.).	The Bluetooth Reader are installed per the plans and specifications. The Antenna should be able to see across all travel lanes. Mounting Height: _____	Pass ___ Fail ___
3	The Technician shall use the Laptop to connect to the BT Browser based application locally with its assigned IP address. The Inspector shall use the Command Prompt and ping the Bluetooth server and any other accessible remote site.	Browser Application should be accessible locally and Bluetooth Reader should receive an ICMP confirmation from the Bluetooth server.	Pass ___ Fail ___
4	Ensure the BT unit can read MAC addresses from Bluetooth	Bluetooth unit will read and display MAC	Pass ___ Fail ___

LHUB: _____ BLUETOOTH READER SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
	Enabled devices.	addresses from Bluetooth enabled devices.	
5	Confirm the frequency range is between 2.402-2.48 GHz.	Confirm the frequency range is between 2.402-2.48 GHz by referencing datasheet of spectrum analysis.	Pass ___ Fail ___
6	Confirm there is a seamless restart to the BT Reader devices upon a simulated power failure. The Technician shall disconnect the antenna cable and confirm the loss of connection with device. Reconnect the antenna cable.	The device should be back online and streaming data upon restoration of power.	Pass ___ Fail ___
7	Use a laptop to connect to the Bluetooth Browser based application and verify lane information.	The software should show the proper number of lanes being detected, as applicable to the installation location.	Pass ___ Fail ___
8	Note the MAC Address of the BT test device (Bluetooth Vehicle/Cellphone). The Bluetooth reader shall be able to detect and read the MAC addresses of BT equipped vehicles or devices circulating along the roadways in each respective direction of travel when passing next to the antenna. The Bluetooth Browser based application shall be accessed and confirm the Test device's MAC Address shall be observed in the software.	The BT test device MAC address should match the MAC address located within the reader range of 300 feet prior to the BT reader in each applicable direction of travel.	Test MAC Address: _____ Time stamp _____ Pass ___ Fail ___
9	Using a laptop, to connect to the Bluetooth Browser based application locally with its assigned IP address. The software	Number of Macs Addresses Read _____ Current	Pass ___ Fail ___

LHUB: _____ BLUETOOTH READER SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
	shall be used to show the data logging and statistics of the local reader. Record the results of all data values currently being processed by the Reader.	Voltage _____ Average Voltage _____ Temperature _____ Sensitivity _____ Transmit Power _____	
10	Ensure the unit can read no less than 90% of all MAC addresses located with a 300 ft. radius.	Count the number of possible Bluetooth enabled devices for one minute. Divide number of possible Bluetooth enabled devices by manual count. Count should be within 90%.	Pass ___ Fail ___

RPMU Name: _____ Local Hub: _____ Station: _____
 RPMU Voltage Reading: _____
 Product Manufacturer's Name: _____
 Product Make: _____
 Product Model: _____
 Product Serial Number: _____
 Product Firmware Version Number: _____
 Product IP Address: _____
 Product Gateway: _____
 Product Subnet Mask: _____

LHUB: _____ RPMU SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
1	Verify RPMU is installed per the plans and in compliance with the Specifications.	RPMU is installed correctly per the plans.	Pass ___ Fail ___
2	Verify proper voltage is provided from each output port.	Voltage for each output port is between Nominal 115VAC and 125VAC.	Pass ___ Fail ___ VAC In _____
3	Verify proper voltage continues through output ports following disconnection from constant power source.	Voltage for each output port is between Nominal 115VAC and 125VAC after constant power source is removed.	Pass ___ Fail ___ VAC In _____
4	Verify that the RPMU is accessible through an HTTP connection via a web browser.	RPMU is accessible through a web browser.	Pass ___ Fail ___
5	Verify the RPMU has been configured with the proper location name and system information.	RPMU has been properly configured for location name and system information.	Pass ___ Fail ___
6	Verify all Ports on the RPMU are labeled correctly for the corresponding equipment attached to the port within the configuration.	All ports are labeled correctly for the corresponding devices attached to the port.	Pass ___ Fail ___
7	Verify that SNMP settings are properly configured according to the information provided by the District.	SNMP settings are properly configured.	Pass ___ Fail ___
8	Log into the RPMU from a web browser and turn power off/on to	Power was remotely turned off/on for all ports	Pass ___ Fail ___

LHUB: _____ RPMU SERIAL #: _____			
Step Number	Procedure	Expected Results	Results/Comments
	confirm remote power control functionality of all ports.	remotely.	

7. RPMU Device (Continued)

Field Acceptance Test Witness Signatures

Technician Name: _____

Technician Signature: _____

Date: _____

Device Serial Number: _____

Test Start Time: _____

Test Finish Time: _____

Test anomalies and comments (if applicable) _____

Department Rep. Name: _____ Department Rep. Signature: _____

8. Wrong Way Driving System (WWDs)

Field Acceptance Test (FAT)

WWD Location: _____ Local Hub: _____ Station: _____
WWD Sensor Voltage Reading: _____
Product Manufacturer's Name: _____
Product Make: _____
Product Model: _____
Product Serial Number: _____
Product Firmware Version Number: _____
Product IP Address: _____
Product Gateway: _____
Product Subnet Mask: _____

To ensure proper WWD operation the following items will be used to conduct the test:

- 1) Manufacturer Supplied Sensor and WWD Software
- 2) Laptop Computer
- 3) Ethernet Cables
- 4) One Small Vehicle with OBU and HMI
- 5) One Large Vehicle with OBU and HMI

Step 1: Physical Verification

Visually verify all control cabinet equipment and cabling for proper installation. This includes verification that all power supply voltages and amperages to the devices are in the appropriate range. Additionally, verify that the controller clock is accurate or connected to the NTP to ensure that the date/time stamp of event logs are accurate.

Step 2: Establish Communication

Connect the Communications Cable from Laptop to controller. Apply power to all devices and the laptop; establish communication from the laptop to the device.

Step 3: Configuration Parameters

Verify all configuration parameters for the CV application.

Step 4: Vehicle Detection and Vehicle Classification Accuracy Test

Verify the proper vehicle detection and classification for WWD CV application. This is verified by the Accuracy Testing procedures and actuation of highlighted signs and TIM broadcasting.

8. Wrong Way Driving (Continued)

TEST EQUIPMENT REQUIRED

1. One set of cabinet keys
2. Laptop Computer
3. WWD Vendor Software
4. Ethernet Cables
5. One Small Vehicle with OBU and HMI
6. One Large Vehicle with OBU and HMI

LHUB #: _____ WWD #: _____ Serial #: _____ Date: _____.			
Step Number	Procedure	Expected Results	Results/Comments
1	Verify and document proper input and output voltages from the power supply to the WWD devices in-cabinet.	Input voltage to Power Supply is per the WWD device specifications.	Pass _____ Fail _____ VAC in _____ VDC out _____
2	Using a laptop computer, establish communication with the WWD sensors using the vendor software or graphical user interface. This is to ensure the user can configure detection zone parameters.	Communication is established between the processor and the sensors.	Pass _____ Fail _____
3	Verify that the sensor(s) position have been set to the correct height, direction (N, S, E or W) and angle to configure detection zones and recording functionality.	Sensor position is set to the appropriate height, direction, and angle based on the manufacturer's guidelines and is verified by the video capture displays available from the vendor software.	Pass _____ Fail _____
4	Verify that the WWD CV application is processing the data store options for event logs, static images for up to 10 seconds and is resetting the recording options per user requirements. <i>Note: Configuration parameters may be set to manual or automated based on user needs.</i>	Event logs, Image capture and recording options are active.	Pass _____ Fail _____

LHUB #: _____ WWD #: _____ Serial #: _____ Date: _____.			
Step Number	Procedure	Expected Results	Results/Comments
5	Verify access to the Data Logs, WWD image from the WWD Processor.	Access to files.	Pass _____ Fail _____
6	Verify that detection zones for Wrong-way Detection are configured with the appropriate TIM message defined for “immediate forward” to the RSUs once a verified WWD is detected. <i>Note: Multiple detection zones may be defined based on user needs.</i>	1. Wrong-way detection zones are configured. 2. Wrong-Way driving (WWD) TIM message is defined and operational for broadcast as “immediate forward mode” to the RSUs.	Pass _____ Fail _____
7	Verify that the processor is configured for converting CV messages to J2735 format, generating the Traveler Information Messages (TIM) to one and/or multiple selectable RSU(s).	TIM is enabled for CV message broadcasting with a pre-defined message indicating of a WWD. Verified using an OBU and HMI for graphical displays.	Pass _____ Fail _____
8	Verify that email and/or text notifications are enabled to automatically notify of a WWD requiring the user to take an action.	Email or Text notification notifications are enabled.	Pass _____ Fail _____
9	Verify that SunGuide® software has received all alerts and clear images in accordance with the contract documents and that the alerts contain accurate information related to the WWD incident.	SunGuide® provides access to clear images, accurate alerts, and information related to the WWD incident. Alerts may include email or other trigger notifications of a WWD.	Pass _____ Fail _____
10	Start the WWD accuracy and false-positive testing in accordance with the procedures outlined on the following pages.		NA

LHUB #: _____ WWD #: _____ Serial#: _____ Date: _____.

Field Acceptance Tests

This test shall verify the WWD functional operation at the field site. No connection to network is needed for the Field Acceptance Test.

Purpose: To verify that the WWD detection device functions properly per FDOT Specification 660-4.4.

Objective: To Demonstrate that the vehicle detection device meets or exceeds the minimum requirements of the functional requirements.

Expected Results: The vehicle detection device will satisfy the functional requirements and the minimum performance accuracy described below.

Procedures:

Classification: An Accuracy Test of the Wrong-Way Alert System is conducted by using a small test vehicle (Compact Vehicle Category) and a large test vehicle (Pickup Truck or SUV Category). Each vehicle will be driven the wrong direction on each travel lane, including all paved shoulders twice at 10-15 MPH and twice at 30-50 MPH. The WWD System will activate with a TIM CV message broadcast as well as activation of highlighted signs.

Once a wrong-way driver is detected, the camera will automatically track and begin to take still-images of the wrong-way driver/motorist. An alert/notification will be sent, and a sequence of image captures for up to ten (10) seconds shall be demonstrated. If a test fails (either passes), that given test phase must be conducted successfully 3 times in a row prior to a successful completion of the test.

Detour routes and associated MOT are required for the testing and are detailed in the plans.

If calibrations are performed, including physical sensor aiming or calibrations that affect other test lanes that have previously passed, the test procedure must start over from the beginning.

Record the results for each Accuracy Test and identified Lane on the table, on the following page.

8. Wrong Way Driving (Continued)

Test Type	Wrong-Way Driving Test Pass 1 (10-15 MPH)			Wrong-Way Driving Test Pass 2 (10-15 MPH)			Wrong-Way Driving Test Pass 3 (30-50 MPH)			Wrong-Way Driving Test Pass 4 (30-50 MPH)		
	Lane 1	Lane 2	Shoulder									
Small Vehicle <i>-Highlighted Signs Active-</i>												
Small Vehicle <i>-TIM Active-</i>												
Small Vehicle <i>-Images Active-</i>												
Large Vehicle <i>-Highlighted Signs Active-</i>												
Large Vehicle <i>-TIM Active-</i>												
Large Vehicle <i>-Images Active-</i>												

NOTE: If either of the Test Passes fail, perform test until 3 consecutive successful passes are obtained.

Field Acceptance WWD Accuracy Test Passed

Yes____ No____