SMART TECHNOLOGY SYSTEMS – STS

ETA® International Basic STS Certification

Competency Requirements

There are **two** levels of expertise for those who install and integrate smart electronics technology into structural systems which are residential and light commercial properties. **STS** installation technicians are responsible for interconnecting electronics communications, data, computer, control or entertainment equipment and converging signals into one faultless system. The two levels for those installation technicians are the **Basic STS**, Basic Smart Technology Systems and the **Master STS**, **Smart Technology Systems - Master Integrator (STSmi)**.

The **BASIC STS** installation technician is proficient in the design of pre-wiring and wireless architectures in residential/light commercial for entertainment, internet of things, and telecommunications equipment interconnections. This will include installation of network wiring for TV, satellite and antenna outlets, voice equipment outlets, audio and video, media streaming, and computer equipment in such a manner that all control and communication signals can be integrated at the home or business system controller and converged into one cogent local network bit stream, to either be used within the system or to be passed back and forth through the system gateway. He/she will be proficient in the many protocols used over diverse media to communicate with and control an array of electronics systems, in addition to the skills required for low voltage wiring installation. Prior CAT, DCI, DVE, FOI, FOT, FOT-OSP, TTT certification is highly recommended to be proficient in STS skills. The Basic STS installation technician will work from telecommunications wireless and wiring plans, installing cable fittings and selecting the specified cabling for each technology and identifying wireless equipment requirements. He/she will test, mark and document all cabling and will have the ability to troubleshoot and restore pre-existing cabling and wireless systems. A Basic STS installation technician typically will also be qualified in one or more of four (4) endorsement specialty areas listed below.

The **STS MASTER INTEGRATOR (STSmi)** will be proficient in **all** of the core STS skills and knowledge including planning and designing the layout for electronics and communications equipment systems for new construction and retro-fit/remodeling. The STS MASTER INTEGRATOR is capable of designing the entire system and network for audio, video, data and control of security and environment to function in one local network bit stream converged at the system controller. He/she is also capable of troubleshooting, debugging and optimizing the system of planned installations or modifications. The STS MASTER INTEGRATOR has extensive knowledge of the operation and technology and is proficient in each of the basic and four endorsements of STS electronics.

STS CERTIFICATION PROGRAM overview:

- **Basic STS:**

The Basic **STS** installation technician can become certified with ETA® International by passing the knowledge examination assessments, based on the following **STS BASIC Skills & Knowledge Competency**.

In addition, **STS** certification holders can also acquire one or more of the four (4) endorsement certifications, as listed below:

1. **Audio-Video**
2. **Computer Networking**
3. **Environmental Controls**
4. **Security-Surveillance**

- **STS MASTER INTEGRATOR (STSmi), MASTER STS:**

The **MASTER STS** certification prerequisites include successfully completing the Basic STS certification requirements, plus earning **each** of the four (4) STS endorsements.
To qualify for the ETA Smart Technology Systems MASTER INTEGRATOR, a technician must:

- Hold the STS Basic certification
- Hold each of the four (4) specialty endorsements
- Pass the separate **STS MASTER INTEGRATOR (STSmi)** examination

ETA® BASIC STS SKILLS AND KNOWLEDGE COMPETENCIES

1.0 Safety

- 1.1 Identify basic first aid skills including:
  - 1.1.5 Electrical shock treatment
    - 1.1.5.1 List the level of electrical shock (current) considered lethal to humans
  - 1.1.6 Burn treatment
  - 1.1.7 Cuts, scrapes, bleeding treatment
- 1.2 Describe Occupational Safety and Health Administration (OSHA) body restraint rules
- 1.3 List hazards associated with the use of ladders and working at heights (A14 standards)
- 1.4 Explain the purposes and reasons for technician adherence to National Electrical Code® (NEC®) and the other National Fire Protection Association (NFPA) codes
  - 1.4.5 Describe the different classes (A, B, C, D, & K) of fires and extinguishers
- 1.5 Explain the purpose and usage of the Authorities Having Jurisdiction (AHJ) Residential Electrical Maintenance Code (REMC)
- 1.6 Describe other Personal Protective Equipment (PPE) used by electronics and electrical technicians
  - 1.6.5 List fiber optic cable eye, skin and inhalation safety precautions
- 1.7 Describe proper usage and safety concerns for hand and power tools

2.0 Industry Standards

- 2.1 Describe the cabling components, methods, and situations where an installer needs to refer and abide by all levels of American National Standards Institute (ANSI), Telecommunication Industry Association (TIA), and Electronic Industries Association (EIA) standards including:
  - 2.1.1 568-A, -B, -C, .1, .2–D, and .D- (Telecom Cabling for Customer Premises, et al.)
    - 2.1.1.1 Explain how to find correct cable pair colors
  - 2.1.2 569- (Telecommunications Pathways and Spaces)
  - 2.1.3 570- (Residential Telecommunications Infrastructure)
  - 2.1.4 606- (Telecommunications Infrastructure Administration)
  - 2.1.5 607- (Telecommunications Bonding and Grounding (Earthing) for Customer Premises)
  - 2.1.6 758- (Customer-owned Outside Plant Telecommunications Infrastructure)
  - 2.1.7 862- (Cabling Infrastructure for Intelligent Building Systems)
- 2.2 Describe the Telcordia and International Electrotechnical Commission (IEC) standards related to cabling
- 2.3 Identify Wi-Fi™ IEEE wireless 802.11 standards and capacities
  - 2.3.1 Differentiate between 802.11, 802.11b/g/n, 802.11ac, 802.11ac wave 2, and 802.15.4 wireless standards
  - 2.3.2 Differentiate between Z-Wave®, Zigbee, IEEE 802.15.4, and Bluetooth® (802.15.1) technology standards
- 2.4 Describe UL® standards related to residential and light commercial buildings

3.0 Low Voltage Wiring and Wireless Communication Technologies

- 3.1 Interpret use of blue prints including:
  - 3.1.1 adherence to specifications
- 3.2 Explain American Wire Gauge (AWG) wire size standards
- 3.3 List possible governmental (AHJ) permits required to install or service low voltage class wiring
- 3.4 Describe low voltage lighting usage and precautions
  - 3.4.1 Differentiate between low voltage AC and DC LED lighting technologies
- 3.5 Describe current audio/video signal and speaker cabling, wiring and wireless signal choices
  - 3.5.1 Differentiate between 12, 14, 16, 18 and 22 AWG gauge speaker wire
  - 3.5.2 Differentiate between XLR audio connectors, 1/4” and 1/8” phone audio connectors, RCA pin connectors and USB connectors
  - 3.5.3 Differentiate between RCA, VGA (video graphics array), Composite video, Component video, Digital Visual Interface (DVI), S-Video (separate-video) and High-Definition Multimedia Interface (HDMI™) connectors
  - 3.5.4 Describe how Bluetooth® is used for wireless audio connections
    - 3.5.4.1 Differentiate between the types of Bluetooth® wireless technologies

3.6 Describe CAT 5e, 6 and 6_A UTP (Unshielded Twisted Pair) cables and preferred usages
3.7 Describe control and sensor wiring used for residential automation and manual operation
3.8 Explain Z-Wave®, Zigbee, Bluetooth® 1 through 5, Wi-Fi 802.11 and 802.15.4 wireless technologies
    3.8.1 Explain how to tune a wireless network to optimize wireless connections within a building's network and eliminate or mitigate interference from other wireless networks
3.9 Explain how smart phones and other portable wireless devices can be used to connect to smart building's hubs
    3.9.1 Explain how applications (apps) usage and configurations are used on wireless devices to add remote control capabilities to a building's system hubs and appliances
3.10 Differentiate between wireless cell systems connectivity including 4G, LTE, 5G, Gigabit LTE and LTE-A
    3.10.1 Differentiate between packet-switching and circuit-switching systems on a network

4.0 Cabling – Connectorization

4.1 Compare copper coax and plastic optical fiber usage in residential applications
4.2 Define Patch Cable and list the maximum length allowed by standards
4.3 Define Workstation Cables and explain usage
4.4 Define Backbone/Distribution cabling and compare with link, workstation and patch cables
4.5 Differentiate between Composite, HDMI™ and Hybrid Cables
4.6 Describe proper cable prepping tools and equipment including:
    4.6.1 how ends of cables are prepared for connectors
    4.6.2 how connectors are properly crimped
4.7 List the types of signal losses (attenuation) in cables including:
    4.7.1 the purpose of matching correct impedances
    4.7.2 converting decibel (dB) levels to microvolt (µV) levels
4.8 Describe how to properly prep and install F coaxial cable fittings
    4.8.1 Explain impedance problems
4.9 Describe how to properly install UTP, CAT 5e, 6 and 6_A fittings
4.10 Explain how and why ground loops occur in electrical circuits
4.11 Identify how modems, routers, bridges and Z-Wave® hubs operate
4.12 Summarize basic optical light theory and list commonly used wavelengths/frequencies
4.13 Describe optical fiber:
    4.13.1 connectors
    4.13.2 splice methods
    4.13.3 testing
4.14 Differentiate between glass and plastic optical fiber (POF) including:
    4.14.1 design
    4.14.2 IEEE802.3bv ratification
    4.14.3 distance limitations of POF

5.0 Pre-wiring

5.1 Describe the task of "roughing-in" cabling in new structures, installing wall boxes, conduit, distribution boxes, speaker in-wall units, security-surveillance (CCTV) mounts, etc.
    5.1.2 Describe surface mount channeling and how it is utilized
5.2 Explain the purpose and usage of biscuit jacks/surface mount boxes
5.3 Explain the use of wall plates and indicate proper locations
5.4 Describe purposes and locations for J-hooks, hangers and cable trays (cable management)
5.5 Explain inductive signal interference including:
    5.5.1 the effects and precautions
    5.5.2 separation distances for cabling
        5.5.2.1 Explain alien crosstalk (AXT)
5.6 List advantages of stranded versus solid wiring
    5.6.1 Explain the reasons for choosing either
5.7 Describe why staying within the TIA/EIA-568 Tensile Strength/Bend Ratios is important
5.8 Outline the purposes of wiring labeling and how applied as specified in ANSI/TIA-606-B
5.9 Explain methods used to closely estimate cable requirements for individual applications
5.10 Explain UTP untwist precautions including
    5.10.1 Near end crosstalk (NEXT)

5.10.1.1 attenuation-to-crosstalk ratio (ACR) in decibels (dB)
5.10.2 Far end crosstalk (FEXT)
5.10.2.1 attenuation-to-crosstalk ratio, far end (ACRF) in decibels (dB)
5.11 List common problems encountered in coaxial cable installation or repair

6.0 Electrical Basics

6.1 Explain Ohm's Law calculations using each formula type including:
6.1.1 voltage (E or V)
6.1.2 current (I)
6.1.3 resistance (R)
6.1.4 power (W or P)
6.2 Explain electric power generators and service to structures
6.2.1 Identify how power generators can be connected to smart technology systems and provide uninterruptible power supplies (UPS)
6.3 Describe wire size (conductor class) choices and distribution for residential and light commercial electrical circuitry
6.4 Compare over-current/overload protection of fuse and circuit breaker boxes in electronics applications
6.4.1 Describe the components and meter
6.4.2 Explain lightning hazards and arrestors
6.4.3 Explain the use of ground blocks
6.5 Compare DC and AC current and voltages
6.6 Explain the purpose of electric circuit grounding and NEC® rules for residential and light commercial buildings
6.7 Compare AC power frequency, voice, radio, TV and data frequencies
6.8 Describe causes of electromagnetic interference (EMI)
6.8.1 Explain how to mitigate EMI

7.0 Communications Systems

7.1 Diagram a basic telephone circuit
7.1.1 POTS (plain old telephone service)
7.1.2 VOIP (voice over internet protocol)
7.2 Define Tip and Ring and show wiring conventions in POTS systems
7.2.1 List expected voltages on telephone plugs
7.3 Name the conventional color of UTP wires used with 2/4/8 wire connections
7.4 Compare Analog and Digital telephone systems
7.5 Explain where Punch Down Blocks – 66/110 are used and their purpose
7.6 Compare the various cordless phone standards and their advantages/disadvantages
7.7 Differentiate between Internet - Cable TV - Wireless Systems and B-VoIP
7.8 Summarize common troubles associated with telephone systems and suggest repair solutions including:
7.8.1 cut underground phone drop
7.8.2 interface lightning damage
7.8.3 poor punch-down or equipment connections

8.0 Residential and Light Commercial Management

8.1 Explain bar coding and modern inventory control methods
8.1.1 Explain how inventories of perishable goods can be maintained with smart technology systems
8.2 Explain manual, automatic and programmable appliances control
8.2.1 Describe how appliances can be controlled through wireless technologies such as Bluetooth®, Z-Wave® and Zigbee wireless technology
8.3 Identify the areas where smart technology can be used within buildings
8.3.1 Explain how voice recognition and voice activation systems are installed and used for smart technology systems
8.3.2 Identify the environmental and HVAC functions that can be performed and monitored by smart technology systems
8.3.2.1 Describe procedures and processes required to provide environmental controls within a building

8.3.2.2 Explain sensor data fusion
8.3.2.2.1 Describe how sensor data can be used to control HVAC and other environmental systems
8.3.2.2.2 Explain the use of zones in HVAC systems and how sensor data can be used to manage temperature zones
8.3.3 Explain how “If This, Then That” IFTTT scripts or “recipes” are used to develop rules for managing automated processes with in a building
8.3.4 Explain how smart technology systems can be used for security
8.3.4.1 Describe how motion detection and infrared security curtain systems operate
8.3.4.2 Describe the different types of security cameras that are available:
8.3.4.2.1 PTZ cameras
8.3.4.2.2 Wi-Fi™ cameras
8.3.4.2.3 Motion detection cameras
8.3.4.2.4 Door Bell cameras
8.4 Explain how different devices within a building can be paired and controlled by smart technology system hubs connected to the wireless network
8.4.1 Describe how smart technology system hubs can be extended throughout a building using hub repeaters or extender devices
8.4.2 Describe how voice activation systems can be integrated with smart technology system wireless hubs
8.5 Explain how entertainment systems can be connected to smart technology systems and how all room speaker systems can be set up wirelessly
8.6 Explain the ways that a building’s monitoring system can be interfaced to health monitoring systems through an internet gateway
8.7 Identify the resolution differences in NTSC (National Television System Committee) versus PAL (Phase Alternation by Line) SDTV (Standard Definition), HDTV (High Definition), and UHD (Ultra High Def. 4K and 8K) TV displays
8.7.1 Explain the differences in pixel counts for the various TV displays
8.7.2 Describe the various cables that can be used to connect TV displays to video sources

9.0 Premises Restoration

9.1 Describe the need for drywall and other penetrations of walls and ceilings in retrofit applications
9.2 Describe restoration techniques and list materials used

10.0 Tools and Equipment

10.1 Explain usage Analog and Digital Multimeters (DMM) in residential/light commercial building cabling
10.1.1 Describe each Volt/Ohm/Amp function
10.2 Describe how to use wire strippers/crimps/punch-down tools and fish tapes
10.3 Explain usage of gopher poles, drills/bits, scissors and face mask
10.4 Explain the use of a toner and light meter/source
10.5 Describe proper installation of F connector using compression tool and fittings
10.6 Explain why wire pull lubricant is needed
10.7 Identify cable using the cable markers and discuss how to identify wires that have no markers
10.8 Identify various types of wireless network analyzer tools used to tune a wireless network

11.0 Customer Orientation and Documentation

11.1 Identify the cybersecurity risks associated with Smart appliances and TVs
11.2.1 Explain what a potential customer needs to know about privacy concerns and internet connected appliances
11.2.2 Explain what a potential customer needs to know about the vulnerabilities associated with Bluetooth® technology
11.2 Explain how to briefly highlight important points in customer’s equipment manuals and specification sheets
11.3 Describe how to present plans, drawings, estimations, and final report to a customer

12.0 Basic Troubleshooting

12.1 Explain the “Divide and Conquer” troubleshooting method
12.2 List common problems and solutions in building cabling
12.3 Identify sources of on-line and phone technical help from product makers and suppliers

End of Basic SMART TECHNOLOGY SYSTEMS Competency

Suggested Additional Resource and Study Material:

NFPA 70®: National Electrical Code®, 2020; National Fire Protection Assn., Sept.,2019; www.nfpa.org
Commercial Low-Voltage Wiring; Brooks, Stroud; ISBN 978-1581220858; Marcraft, ETG Brand; 2012
Cabling: The Complete Guide to Copper and Fiber-Optic Networking, 5E; Oliviero & Woodward; ISBN 978-1118807323; Sybex, Inc.; 2014; softcover; 1284 ppg**.** Available through ETA 800-288-3824, www.etai.org
Introduction to Low Voltage Systems, 2E; DiPaola & DiPaola; ISBN 978- 1111639532; Delmar Cengage Learning; 2012; (with Lab Manual, ISBN 978-1111639549)
Residential Wiring and Smart Home Technology; Rockis & Rockis; ISBN 978- 0826918338; ATP; 2018
Cybersecurity Essentials, 1st Ed; Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short; ISBN 978-1119362395; Sybex; Oct.2018; 784 pgs
Telecommunications and Data Communications Handbook; Ray Horak; ISBN 978-0470041413; Wiley-Interscience; September 2007; Paperback; 791 ppg**.**
RESI library; Charles J. Brooks with Max Main, eITPrep LLP, Marcraft: **5 texts in Basic, A&V, CN, EC, and S&S;** ISBNs various; 2007 - 2009;
Residential Integration Series library; Cengage Learning Delmar; **4 texts in Basic, P.M., Certification, and Integration;** ISBNs various; 2006 - 2008;

Call (1-800-288-3824) or contact ETA (eta@etai.org) for other white papers, pdfs, power points, etc...
Including **STS Domain 1 training at Education Forum 2019 JB Groves III March 4-6, 2019**

Many webpages and links are available searching online, some examples are:

http://www.etai.org/smart_home.html
https://www.z-wave.com/
https://www.CSA-iot.org/ (Connectivity Standards Alliance, formerly Zigbee.org, ZigbeeAlliance.org)
https://www.bluetooth.com/
https://www.nfpa.org/
https://www.wi-fi.org/
https://lora-alliance.org/
https://standards.ieee.org/standard/
http://www.marcraft.com/RESI.html
https://www.tiaonline.org/
http://www.iec.ch/
https://www.nema.org/pages/default.aspx
https://www.iccsafe.org/
https://www.electronicdesign.com
http://resources.rohde-schwarz-usa.com/c/white-paper-testing-?x=zQSHFI

ETA certification programs are accredited through ICAC, complying with the ISO/IEC 17024 standard.

ICAC International Certification Accreditation Council

