ESP32 T7S3 MultiFunctionUniversalTurnout Configuration Suppliment

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Chapter 1

Introduction

This suppliment documents the configuration for the ESP32 T7S3 MultiFunctionUniversalTurnout firmware. The configuration options available are described in detail and should aid in the proper configuration on the board. There are configuration options relating to the board's core connectivity, including its node id covered in Node id configuration, its WiFi configuration, covered in WiFi Configuration and WiFI Node Configuration.

Then there is configuration for the General I/O connections:

- Push button inputs in Button Configuration.
- LED/Driver outputs in LED (driver) Configuration.
- Occupancy Detectors in Occupancy Detector Configuration.
- [Turnout] Points Configuration in Points Configuration
- Servo Turnout Configuration in Servo Turnout Configuration (when using the servo daughter board and the servo firmware.)
- [Non-server] Turnout Configuration in Turnout Configuration
- Signal Mast Configuration in @MastConfig

Then there is the logic (conditionals) described in Logic Configuration and the track circuits described in Track Circuit Configuration.

Chapter 2

Node id configuration

This is the identifier to use for this device. NOTE: Changing this value will force a factory reset.

The initial default value is a placeholder value and should be changed the first time the node is powered up.

A node id range can be acquired at https://registry.openlcb.org/requestuniqueidrange#new_tab

2.1 Configuration Options

There is one configuration option. It is the string representation of the node id, in the form xx.xx.xx.xx.xx.xx, where each xx is a 2 digit hex number representing one 8-bit byte (00 to ff).

Updating this option will cause the node to reboot with a factory reset configuration (except for the node id). The node id is stored in a separate persistent storage area.

Chapter 3

WiFi Configuration

This configuration group configures the Wifi settings for the node.

3.1 WiFi mode

Configures the WiFi operating mode: Off or Station Only.

3.2 Hostname prefix

Configures the hostname prefix used by the node. Note: the node ID will be appended to this value.

3.3 Station Configuration

Configures the station WiFi interface on the ESP32 node. This is used to have the ESP32 join an existing WiFi network.

3.3.1 SSID

Configures the SSID that the ESP32 will connect to.

3.3.2 Password

Configures the password that the ESP32 will use for the station SSID.

Chapter 4

WiFI Node Configuration

- WiFi Power Savings Mode When enabled this allows the ESP32 WiFi radio to use power savings mode which puts the radio to sleep except to receive beacon updates from the connected SSID. This should generally not need to be enabled unless you are powering the ESP32 from a battery.
- Connection Mode Defines whether to allow accepting connections (according to the Hub configuration), making a connection (according to the Uplink configuration), or both.
  This setting can be set to Disabled if the ESP32 will be using the TWAI (CAN) driver instead for the connection to other nodes.
  Note: it is not recommended to enable the Hub functionality on single-core ESP32 models.
- Hub Configuration Configuration settings for an OpenLCB Hub
- Node Uplink Configuration Configures how this node will connect to other nodes.

Chapter 5

Button Configuration

There are 4 button inputs. These are Schmitt trigger inputs that are design for push buttons switching to ground. There are three configuration variables for each input: a short text description field and a pair of events.

- Description User name of this button.
- Button Released This event will be produced when the button is released.
- Button Pushed This event will be produced when the button is pushed.

Chapter 6

LED (driver) Configuration

There are 4 LED driver outputs. The board has places for inserting through hole load resistors. The drivers are push-pull types, so that can both sink and source current. There are terminals for connecting a 12 VDC power source for these outputs.

Each output has 4 configuration variables. One controls how the output will be operated, this includes stady on, either high side or low side, a single pulse (good for decoupling electromagnets), either high side or low side, or blinking in three speeds in either of two phases.

- LED Steady, Pulse, or Blink Phase (A-B) The is the LED display mode. One of these options are available:
  - Steady Highside
  - Steady Lowside
  - Pulse Highside
  - Pulse Lowside
  - A - Slow
  - A - Medium
  - A - Fast
  - B - Slow
  - B - Medium
  - B - Fast
- Pulse width in seconds, 1 to 127 (for pulse options)
- LED on This event will be consumed to turn the output on.
- LED off This event will be consumed to turn the output off.

The A and B options are blink, with A and B opposite phases - when A is

on, B is off and when B is on, A is off.

Chapter 7

Occupancy Detector Configuration

There are 4 CT transform type Occupancy Detectors on the board. Each detector has 4 configuration variables, including a textual name, a debounce setting that can be increased if needed (usually for dirty tracks or wheels), and thr two events produced by the detector.

- Description User name of this block.
- Debounce parameter Amount of time to wait for the input to stabilize before producing the event. Unit is 30 msec of time. Usually a value of 2-3 works well in a non-noisy environment. In high noise (train wheels for example) a setting between 8 – 15 makes for a slower response time but a more stable signal.
  Formally, the parameter tells how many times of tries, each 30 msec apart, the input must have the same value in order for that value to be accepted and the event transition produced.
- Block Occupied This event will be produced when the block becomes occupied.
- Block Clear This event will be produced when the block becomes clear.

Chapter 8

Points Configuration

There are 4 turnout point feedback detectors. Each point feedback detector has 3 configuration variables, a textual description, and a pair of event id produced by the detector.

- Description User name of this set of points.
- Normal This event will be produced when the points are aligned for normal.
- Reversed This event will be produced when the are aligned for reversed.

Chapter 9

Servo Turnout Configuration

The Servo Turnout daughter board provides 4 servo outputs to control 4 turnouts powered with servos. The servo version of the firmware supports these outputs with a set of 7 configuration variables, including textual description, normal and reverse events, servo positioning parameters and a pair of events to control vetoing turnout access.

- Description User name of this turnout.
- Normal Event Receiving this event ID will rotate the servo to its normal configured point.
- Reversed Event Receiving this event ID will rotate the servo to its reversed configured point.
- Servo Normal Stop Point Percentage Normal-end stop point of the servo, as a percentage: generally 0-100. May be under/over-driven by setting a percentage value of -99 to 200, respectively.
- Servo Reversed Stop Point Percentage Reversed-end stop point of the servo, as a percentage: generally 0-100. May be under/over-driven by setting a percentage value of -99 to 200, respectively.
- Veto On Receiving this event ID will lock the turnout.
- Veto Off Receiving this event ID will unlock the turnout.

Chapter 10

Turnout Configuration

The turnout daughter boards provide a selection of turnout motor drivers. The non-server firmware provides 5 configuration variables, including a textual description, a pair of event ids to control the position of the turnout and a pair of veto event ids to allow for locking the turnout.

- Description User name of this turnout.
- Normal Receiving this event ID will align the turnout to normal.
- Reversed Receiving this event ID will align the turnout to reversed.
- Veto On Receiving this event ID will lock the turnout.
- Veto Off Receiving this event ID will unlock the turnout.

Chapter 11

Signal Mast Configuration

There are eight signal masts. The signal masts control the signal lamp driver outputs. Each mast can have up to 8 "rules". Each rule has an appearance that signals how the train should operate at the signal. The rules are described in Rule Configuration.

The mast will produce an event that implements a track circuit message.

- Function Mast Processing, one of:
  - Unused
  - Normal
  - Linked to previous
- Mast ID Mast identification
- (P) Track Circuit Link Address. Copy and Paste into linked Track Circuit. (Read Only)

11.1 Aspect Rules

Eight (8) Aspect rules can be configured for each mast. Rule Configuration

Chapter 12

Rule Configuration

Each rule defines one aspect of a signal mast. Generally the rule is out of the operating rules of the railroad and describe how the train should be operated.

The rule has a name (rule number), a track speed, an event that selects the rule (this is generally an event produced by a logic element, usually based on block occupation and turnout position or possibly set by the dispatcher when operating under CTC. The rule also produces an event when set and when cleared. And then it has an appearance consisting of up to 4 lamps, which can be lit steady or set to blink.

- Name One of:
  - 0-Stop
  - 1-Take Siding
  - 2-Stop Orders
  - 3-Stop Procede
  - 4-Restricting
  - 5-Permissive
  - 6-Slow-Approach
  - 7-Slow
  - 8-Slow-Medium
  - 9-Slow-Limited
  - 10-Slow-Clear
  - 11-Medium-Approach
  - 12-Medium-Slow
  - 13-Medium
  - 14-Medium-Clear
  - 15-Medium-Limited
  - 16-Limited-Approach
  - 17-Limited-Slow
  - 18-Limited-Medium
  - 19-Limited
  - 20-Limited-Clear
  - 21-Approach
  - 22-Advance-Approach

  - 23-Approach-Slow
  - 24-Advance-Approach-Slow
  - 25-Approach-Medium
  - 26-Advance-Approach-Medium
  - 27-Approach-Limited
  - 28-Advance-Approach-Limited
  - 29-Clear
  - 30-Cab Speed
  - 31-Dark
- Track Speed (on approach to signal) One of:
  - Stop
  - Restricting/Tumble Down
  - Slow
  - Medium
  - Limited
  - Approach
  - Approach-Medium
  - Clear/Procede
- (C) Event to Set Aspect. Note: Aspects are cleared automatically by the logic.
- (P) Send this event when the Aspect is set.
- (P) Send this event when the Aspect clears.

12.1 Individual Aspect Lamps

Upto 4 lamps can be lit. See Lamp Configuration for details.

Chapter 13

Lamp Configuration

Each of the up to 4 lamps can be set to be steady on or to blink at a slow, medium or fast rate, with choice of phases. The A and B phases are opposite each other. The lamp brightness and the PWM frequence can also be set.

- Lamp Selection
  - Unused
  - A0
  - A1
  - A2
  - A3
  - A4
  - A5
  - A6
  - A7
  - B0
  - B1
  - B2
  - B3
  - B4
  - B5
  - B6
  - B7
- Lamp Phase (A-B) - Flash Rate
  - Steady
  - A - Slow
  - A - Medium
  - A - Fast
  - None (not used)
  - B - Slow
  - B - Medium
  - B - Fast
- Lamp brightness, hundreths of a percent (0 to 10000)
- PWM Period, in nanoseconds

Chapter 14

Logic Configuration

There are 32 logic elements. Logic elements can be part of a group, which then forms an if then else if then else if ... else chain. Each logic block has two "variables" which are used to retain state information. These variables can be set or cleared via an event pair or via a track circuit (a signal from a distant mast).

The variables can be combined with various logic operators. The result of the logic operation can then be acted on by up to 4 actions.

- Logic description
- Group Function One of:
  - Blocked
  - Group
  - Last (Single)
- Variable #1
- Variable Trigger One of
  - On Variable Change
  - On Matching Event
  - None
- Variable Source One of:
  - Use Variable's (C) Events
  - Track Circuit 1
  - Track Circuit 2
  - Track Circuit 3
  - Track Circuit 4
  - Track Circuit 5
  - Track Circuit 6
  - Track Circuit 7
  - Track Circuit 8
- Variable Track Speed One of:
  - Stop
  - Restricting/Tumble Down

  - Slow
  - Medium
  - Limited
  - Approach
  - Approach-Medium
  - Clear/Procede
- (C) Event to set variable true.
- (C) Event to set variable false.
- Logic function One of:
  - V1 AND V2
  - V1 OR V2
  - V1 XOR V2
  - V1 AND V2 => Change
  - V1 OR V2 => Change
  - V1 AND then V2 => true<
  - V1 only
  - V2 only
  - null => true
- Variable #2
- Variable Trigger One of
  - On Variable Change
  - On Matching Event
  - None
- Variable Source One of:
  - Use Variable's (C) Events
  - Track Circuit 1
  - Track Circuit 2
  - Track Circuit 3
  - Track Circuit 4
  - Track Circuit 5
  - Track Circuit 6
  - Track Circuit 7
  - Track Circuit 8
- Variable Track Speed One of:
  - Stop
  - Restricting/Tumble Down
  - Slow
  - Medium
  - Limited
  - Approach
  - Approach-Medium
  - Clear/Procede

- (C) Event to set variable true.
- (C) Event to set variable false.
- when true "Action when Conditional = True
  - Send then Exit Group
  - Send then Evaluate Next
  - Exit Group
  - Evaluate Next
- when false Action when Conditional = False
  - Send then Exit Group
  - Send then Evaluate Next
  - Exit Group
  - Evaluate Next
- Time Delay before action
- Delay Time (1-60000)
- Interval One of:
  - Milliseconds
  - Seconds
  - Minutes
- Retriggerable One of:
  - No
  - Yes
- Action 1 through 4:
- Condition One of:
  - None
  - Immediately
  - After delay
  - Immediate if True
  - Immediate if False
  - Delayed if True
  - Delayed if False
- Action Event (P) this event will be sent.

Chapter 15

Track Circuit Configuration

- (C) Remote Mast Link Address – Copy from 'Next' Mast and Paste here.