Intelligent Tuner STIT 2.45 GHz

User's Handbook

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List of Revisions

The STIT version to which a given document pertains is coded as

HW=*hh* SW=*ss* TS=*tt*

where *hh* represents the STIT HW version, *ss* represents the STIT SW version, and *tt* represents the touchscreen HW/SW version. The STIT version can be read from **More** screen at the LCD touch panel display by touching the **More** button.

Revision	Date	STIT Version	Note
	09-Oct-13	HW=1.1 SW=1.0 TS=1.1	Original version
A2	01-May-20	HW=1.1 SW=1.0 TS=1.1	Formal modifications
A3	12-Aug-22	HW=1.1 SW=1.0 TS=1.1	Formal modifications

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1. STIT TUNER DESCRIPTION

1.1 Introduction

The STIT[1] intelligent three-stub waveguide tuner (Fig. 1) is designed for manual impedance matching of R26 (WR340) waveguide loads in the 2450 MHz ISM band. Conversely, when terminated in a matched load, the STIT can serve for realization of reflection coefficients covering an extensive area of the Smith Chart. The tuner basic design is derived from the HOMER-Series STHT 2.45-GHz Autotuner.

Each stub is equipped with a stepper motor and a top-travel terminal switch. RS232 or RS422 interface is available to the user for remote control and monitoring, optionally also Controller Atea Network (CAN). The desired stub positions can be easily adjusted and monitored by a built-in 3.2″ color LCD display with a touch panel (touchscreen).

[1] The acronym STIT stands for S-Team Intelligent Tuner.

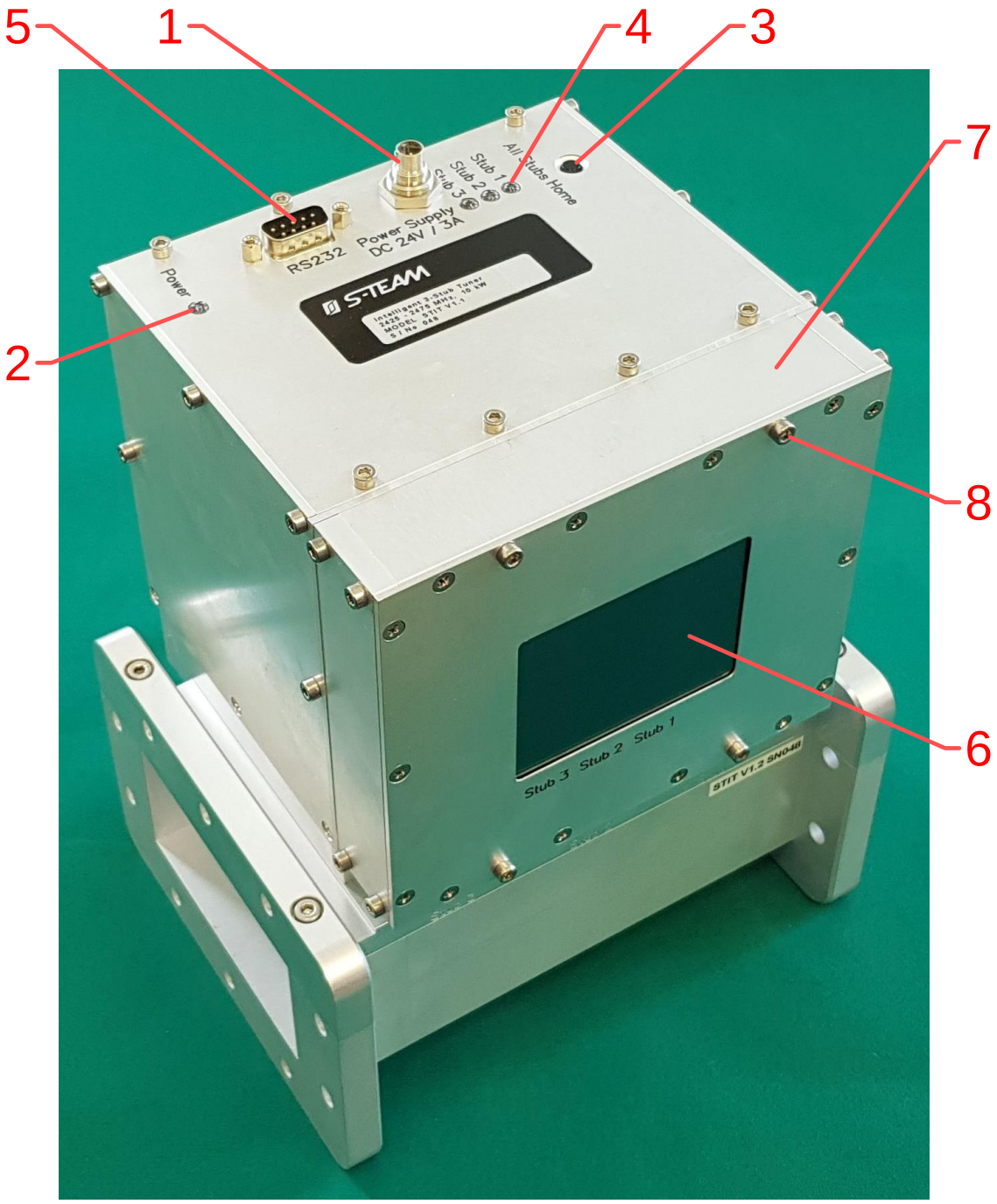


Fig. 1. STIT tuner with the touchscreen module 7 attached.

The tuner elements numbered in Fig. 1 include:

1. Input DC power supply connector. For details, see section DC Power Supply.
2. Green LED indicating whether the device is DC-powered.
3. *All Stubs Home* button, activating the Motors Initialization Routine.
4. Three green LEDs (one for each stub) that shine when the corresponding terminal switch is activated. The lights flash shortly in the course of the All Stubs Home procedure. Persistent shining indicates a motor error (e.g., a mechanically blocked tuning stub).
5. Remote control D9 connector (RS232; optionally RS422 or CAN).
6. Touchscreen.
7. Removable touchscreen display module.
8. Screws for attaching the display module (4 pieces).

The display module can be easily detached by unbolting the four screws (8) and unplugging the back-to-back D9 connector counterparts. The module can then be mounted on a remote-control panel of an industrial installation, using a one-to-one RS232 cable for connection (Fig. 2).

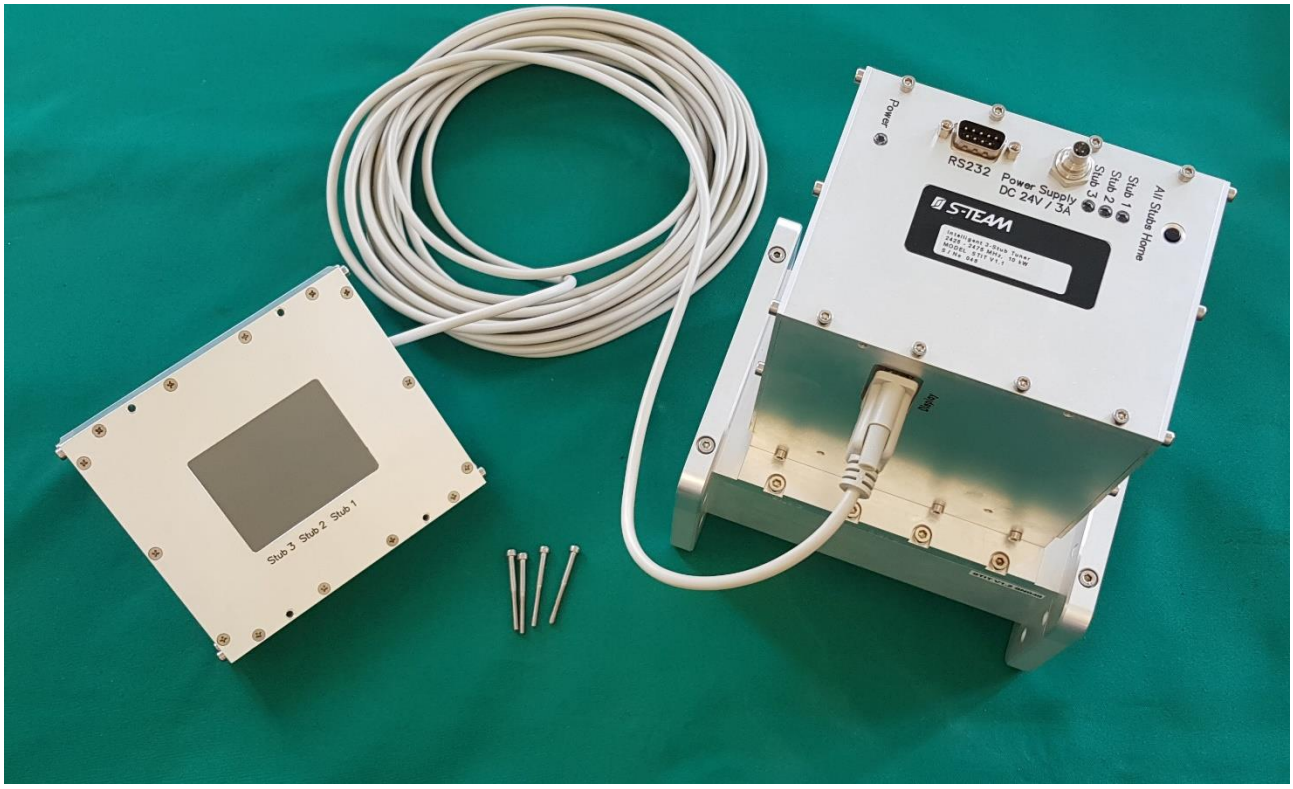


Fig. 2. STIT tuner with the touchscreen display module removed.

1.2 Specifications

Electrical	
Waveguide type	R26 (WR340)
Flange type	IEC
Frequency range	2425 – 2475 MHz
Maximum working power [2]	10 kW
Power supply voltage	24 V ± 10% DC
Peak current consumption (all stubs moving)	3 A
Interface	RS232 or RS422 or CAN
Display	3.2” Wide color LCD with touch-panel
Tuning	
Max tuning stub travel	25 mm
Tuning range	VSWR ≤ 10:1
Full stub insertion travel time	2.3 s
Mechanical and environmental	
Mass	4.6 kg
Dimensions (L × W × H)	**STIT 1.1**: 174 × 138.2 × 225.1 mm **STIT 1.2**: 171 × 138.2 × 225.1 mm
Surface finish	E-CLPS 4600
Operating temperature range	+5 to +55 °C
Storage temperature range	-10 to +70 °C
Optimal conditions for long term storage	+5 to +35 °C, humidity < 75%

[2] Maximum working power is specified for ***matched load*** conditions. For loads with high reflection coefficient magnitude (>0.9), the maximum power applied must be lower to avoid arcing with deeply inserted tuning stubs.

1.3 Dimensional Drawing

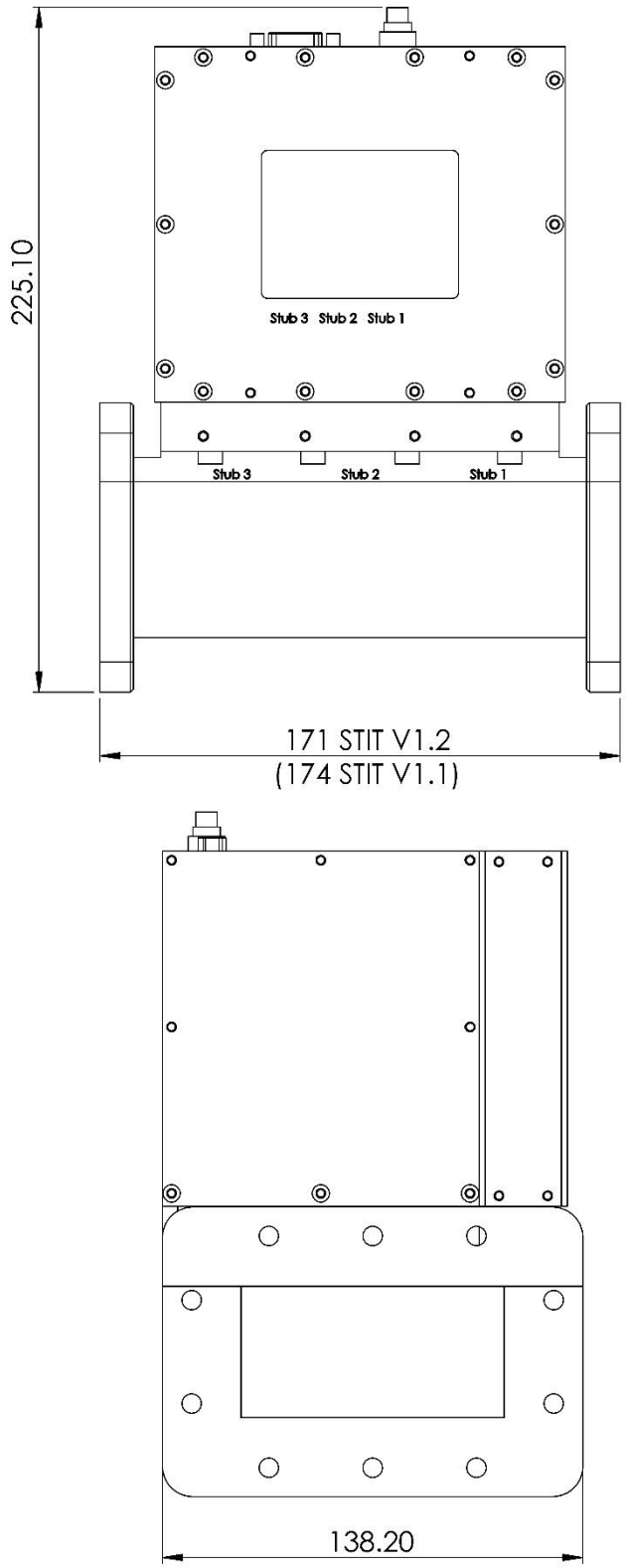
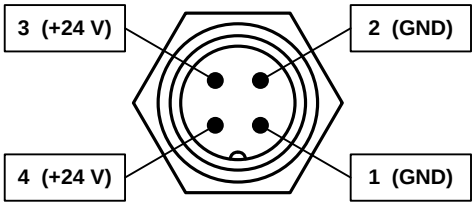


Fig. 3. Basic STIT dimensions (in millimeters).

1.4 DC Power Supply

The tuner is powered from a 24 V ± 10% DC power supply with current rating 3 A. The input is a subminiature 4-pin male panel connector Thomas & Betts TRIAD 01 T01-0560-P04. The connector pinout is shown in Fig. 4. In the cable connector part, the pins with the same polarity should be connected together to relieve the current loading of the pins. A DC power supply cable is a part of the STIT delivery.



Pin	Signal	Remark
1, 2	GND	Power supply – negative polarity (ground, mass)
3, 4	+24 V	Power supply – positive polarity (voltage relative to GND)

Fig. 4. Thomas & Betts power supply connector pinout.

1.5 Connecting Cables

1.5.1 Connection with Display Module

When the display module is separated from the STIT main body (Fig. 2), the connection between the two units can be accomplished using a one-to-one cable with male-female D9 connectors (Fig. 5). Such cables are readily available on the market but can be optionally ordered (standard lengths 3 m and 10 m).

The cable is connected between the connector labeled *Display* located at the side of the STIT and the connector (labeled *Tuner*) at the display module.

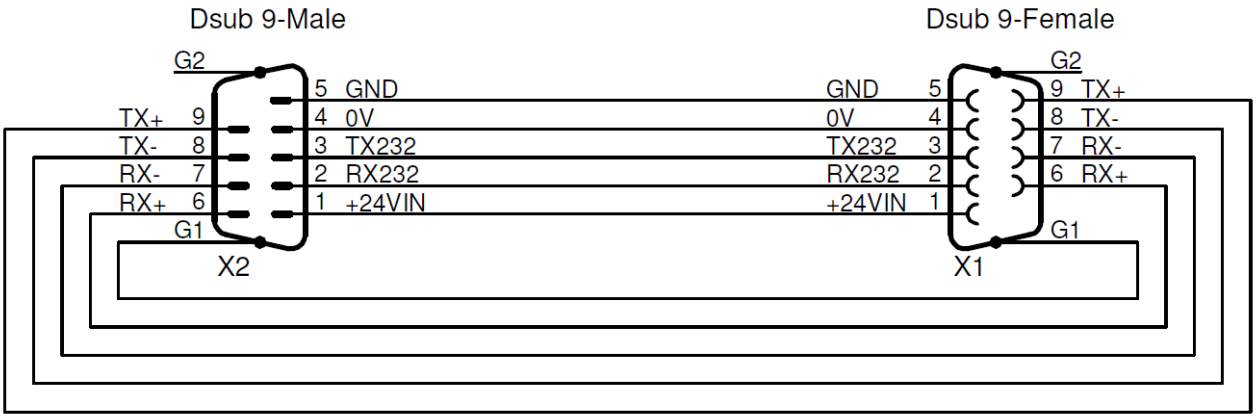


Fig. 5. Wiring of the one-to-one cable used for connecting the detached display module with the STIT main body.

Warning: Do not use for this connection any other cable type from that described above, otherwise the instruments can be damaged.

1.5.2 Connection with External Controller

When the STIT tuner can be controlled by an external computer via RS232 or RS422 interface (connector 5 in Fig. 1), the connection is accomplished via a standard crossed RS232/RS422 cable (null-modem) with female–female D9 connectors (Fig. 6). Such cables are commonly available on the market.

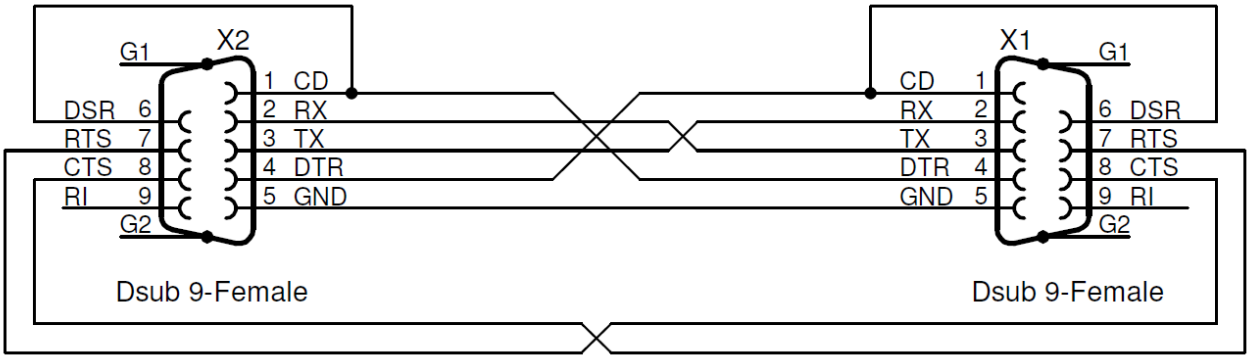


Fig. 6. Wiring of the standard crossed RS232/RS422 cable (null-modem), used for connecting the STIT with a controller.

2. STIT OPERATION USING THE TOUCHSCREEN

2.1 Main Screen

After turning the DC power supply ON, the touchscreen displays the main screen (Fig. 7).

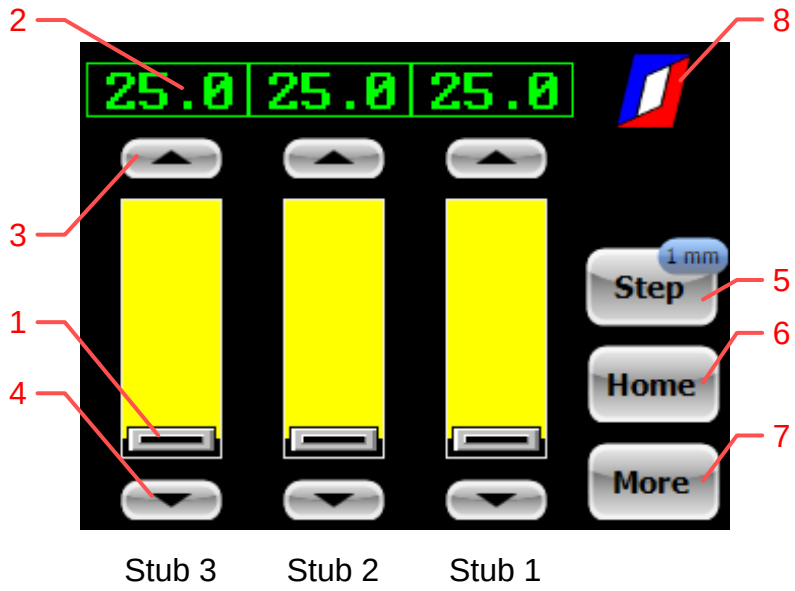


Fig. 7. Main screen of STIT tuner. All stubs are in maximal insertions (25 mm).

The screen includes the following graphic elements:

1. Three sliders, one each for Stub 1, Stub 2, and Stub 3. Labels with stub numbers are attached below the LCD display as well as on the waveguide platform.
2. Numeric displays, showing the current stub extensions in millimeters.
3. **Up** buttons, serving for stepping the stubs upwards (retracting).
4. **Down** buttons for stepping the stubs downwards (extending).
5. **Step** button, selecting the step size for **Up** and **Down** buttons (1 mm or 0.1 mm). The valid step size is shown on the button face.
6. **Home** button, resetting all stubs to zero extensions by invoking the specialized Motors Initialization Routine. The routine resolves any potential lost steps ambiguity.
7. **More** button, opening the second-level More screen for accessing additional functions.
8. Vendor's logo

The main screen serves primarily for setting stub extensions.

2.2 Motors Initialization Routine

The motors initialization routine is activated by touching the **Home** button. It is a procedure which as the first step, withdraws all tuning stubs until their top terminal switches are activated. Then, in a manner that assures high repeatability, the motors are stepped to positions which will become zero extensions (zero-millimeter stub insertion depths). The three LEDs (4 in Fig. 1) should flash only shortly in the course of the procedure. Persistent shining indicates a motor error (e.g., a mechanically blocked tuning stub).
The routine is alternatively denoted as *Reset Stubs*, *All Stubs Home*, or simply *All Home* procedure.

2.3 Setting Stub Extensions

The following options are available for setting stub extensions using the Main screen (Fig. 7):

- Dragging the sliders 1.

- Entering a numeric value after touching a numeric display 2 corresponding to a selected stub.
- Stepping using **Up** and **Down** buttons 2 and 3.

All of the options are quite intuitive.

2.3.1 Dragging Sliders

To move a stub using sliders, touch the corresponding slider by a finger and drag it up or down to a desired position. The stub starts moving after lifting the finger. The display (yellow portion of the stub image) will be periodically updated until the desired extension is reached.

A stylus can be used instead of a finger for more precise control.

To move a stub to a zero or maximum extension, swipe the finger beyond the upper or lower boundary of the rectangle representing the stub.

2.3.2 Numeric Input

To define exact stub extensions in millimeters with 0.1 mm resolution, touch the corresponding numeric display 2. Following this, a numeric keypad screen appears with the numeric display of only the selected stub (Fig. 8). The display shows the actual stub extension. The number will be substituted by the value entered using the keypad as soon as the first numeric button is pressed.

Fig. 8. Numeric keypad for entering Stub 1 extension.

To clear the entered value, press **Clr**. To confirm the entered value and move the stub, press **OK**. To cancel the operation, press **Esc**.

2.3.3 Stepping the Stubs

To step a stub upwards (retracting it), tap the corresponding **Up** button 3. To step the stub downwards (extend it), tap the corresponding **Down** button 4. To select the step size (large, small), press **Step** button. The actual step size will be displayed on the button face.

When the **Up** or **Down** button is held pressed, the stepping continues automatically until the finger is released.

2.4 More Screen

The *More* screen (Fig. 9) serves for accessing additional functions and providing information about the tuner. The menu is activated by touching **More** button in the Main screen.

The display shows the basic information about the tuner, including the tuner HW and SW versions. Also displayed is the tuner internal temperature in Celsius measured at the moment of touching the **More** button.

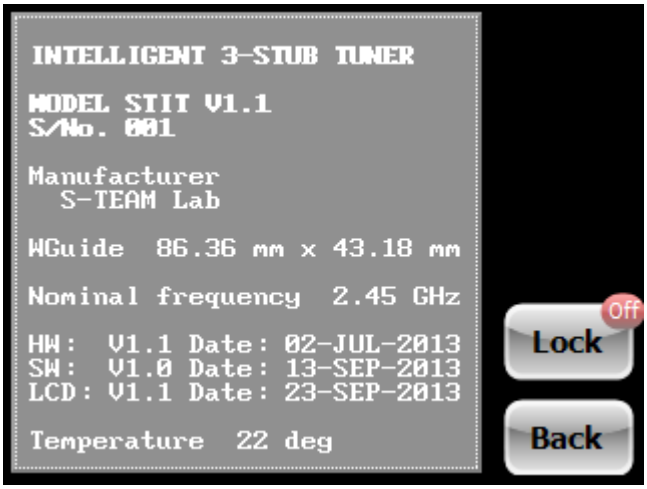


Fig. 9. *More* screen. LCD represents the touchscreen HW/SW version.

On the bottom right, the *More* screen contains buttons **Back** and **Lock**.

- The **Back** button returns the display to the Main screen.
- The **Lock** button is normally in the *Off* state, as shown in Fig. 9. In this state, tuning stubs can be moved freely as described in Setting Stub Extensions.

To prevent unintentional changing of stub extensions, all controls enabling stub movements can be blocked by pressing the **Lock** button once to set it to the *On* state (Fig. 10 left). In this case, the Main screen displays a key (Fig. 10 right). To unlock the controls, press the **Lock** button again.

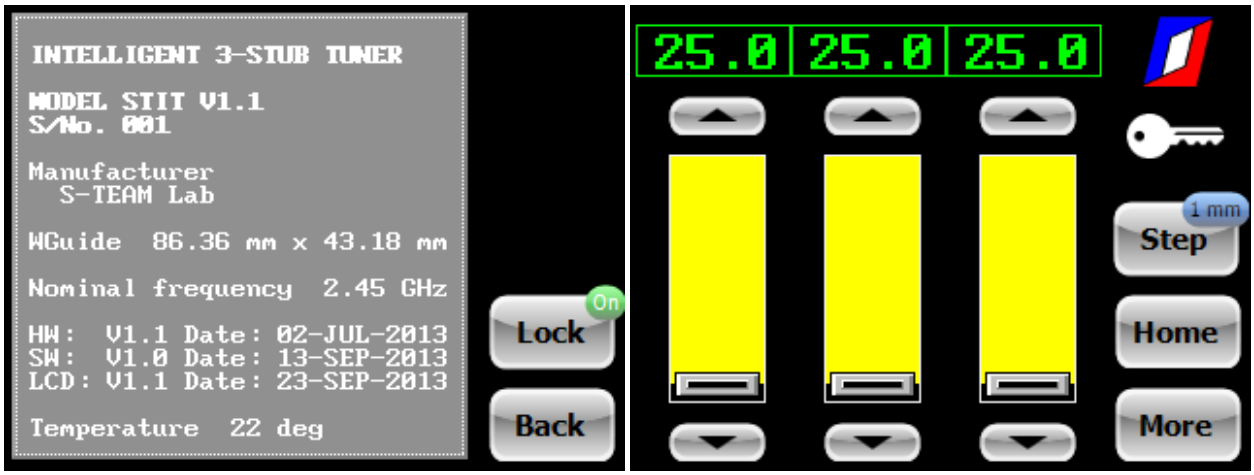


Fig. 10. *More* and *Main* screens in the case when the STIT stub motion controls are locked.

3. REMOTE CONTROL OF STIT

Remote control of an STIT is accomplished via serial interface using the D9 connector at the STIT top panel (5 in Fig. 1). As a standard, the interface is RS232. Optionally, it can be RS422 or CAN Bus.

The communication protocol is described in an accompanying document with a name of the form **STIT_ComProto.pdf**.