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# ZHGUT_V2 SOFTWARE DESIGN SUITE FOR DESIGN OF WIRED INSTALLATION IN ALTIUM DESIGNER – SOLIDWORKS SYSTEM

*This article is dedicated to automation of the design of wired installation of on-board radio electronic equipment for space vehicles. In this paper, we present a software suite that makes it possible to retrieve from the EDA-system a list of wired-wire circuits, to perform its automated processing and generate data for monitoring the electrical bundles of the REE, data for creating a 3D model of electrical wiring in CAD, connections table in accordance with GOST 2.413–72. The software suite makes it possible to reduce the number of errors and the overall time for REE design.*

**Keywords:** *program, wired installation, automation, IDS, instrument making industry.*

Till nowadays CAD systems developers and users in the field of electronics have been maintaining a primary focus on solid modeling and behavior of objects under the different types of action including electromagnetic, thermal and mechanical ones. They also paid more attention to documentation developing. Before now, if we talk about electrical installation design, more attention was paid to print board development and less attention was paid to solid electrical installation works automation. However, a lot of actual CAD systems (SolidWorks, AutoCAD, KOMPAS etc.) are equipped with plug-in modules for wire-based electrical installation design but all of them are targeted at 3d modeling and issuing documentation without association to circuit engineering project part.

Today one of the most popular links among EDA+-CAD systems is Altium Designer (AD) + SolidWorks (SW). In order to create the entire cycle of computer-aided design of electronic radio equipment wiring based on this connection it is required to have an additional intervening medium for data processing and converting. In order to create such a medium»ZHGUTT_V2» software was developed.

«ZHGUT_V2» software consists of three modules: FullNetList (a script for Altium Designer), Harness Graf, «ZHGUT». Wiring development stages and corresponding «ZHGUT_V2» modules are listed in the following table.

Wiring design algorithm using «ZHGUT_V2» software is displayed in Figure 1.

Within the algorithm (Fig.1) Full Net List module completes the following tasks:

1. Automated selection of regular or printed wiring in Altium Designer.
2. Automatic checking of E3 for:

- Different chain names marks within one chain;
- Necessary number of addresses (contacts) within the chain;
- Disconnected or duplicated contacts.

3. Automatic creation of files with the list of links for importing into Harness Graf and «ZHGUT»modules. The list of links consists of:

- Chains list;
- List of Connectors Research and Development of Radio Electronic Equipment and Systems and their contacts;
- The list of components slot names;
- The list of slot contacts.

In order to separate circuits of regular and printing wiring on E3 the designer appoints a special ID to circuits (fig. 2a). The ID is added to the selected circuits. So in the list of links (Fig. 2b) the circuits that start with an ID»P» (P37) will be considered as printed wiring circuits and circuits without this ID will be considered as regular wiring circuits (39, 41, 43). The transfer of the circuit attributes is done by adding the corresponding character (shielding, twisting), which represents an additional component, to the circuit. Such a component is displayed in circuit addresses and therefore it allows to define the circuit as shielded or twisted (circuit 43 on Fig. 2b is screened).

Table «Steps of Wired Installation and Software Used»

| Steps of wired installation | Software Used |
|---|---|
| Selection of Wired Installation Circuits on E3 | Altium Designer (FullNetList) |
| Exporting Wiring Installation Data | Altium Designer (FullNetList) |
| Generating for monitoring electrical integrity of circuits | ZHGUT Software Suit |
| Determining design values of circuits (fragmentation, designating different types of wires) | HarnessGraf |
| Generating connection table (TBE) | HarnessGraf |
| Creating a 3D model of a product with wiring | SolidWorks, «SWR-Electronica» |
| Creating technical Data-sheet | SolidWorks |

The list of links that we receive is imported into modules of Harness Graf and «ZHGUT» software

Within the algorithm (Fig. 1) ZHGUT Software Module fulfills the task of automated generation of electrical test files for testing suit TEST 9110 «POLET». The list of connectors and their contacts is red from the list of links. Then the design engineer assigns the correspondence of tested connector's contacts to the testing suit contacts (Fig. 3). The resulting files are generated automatically. The testing suit controls the electrical integrity of the circuit, isolation resistance, capacitance and other parameters [2].

Within the algorithm (Fig. 1) HarnessGraf module fulfills the following tasks:
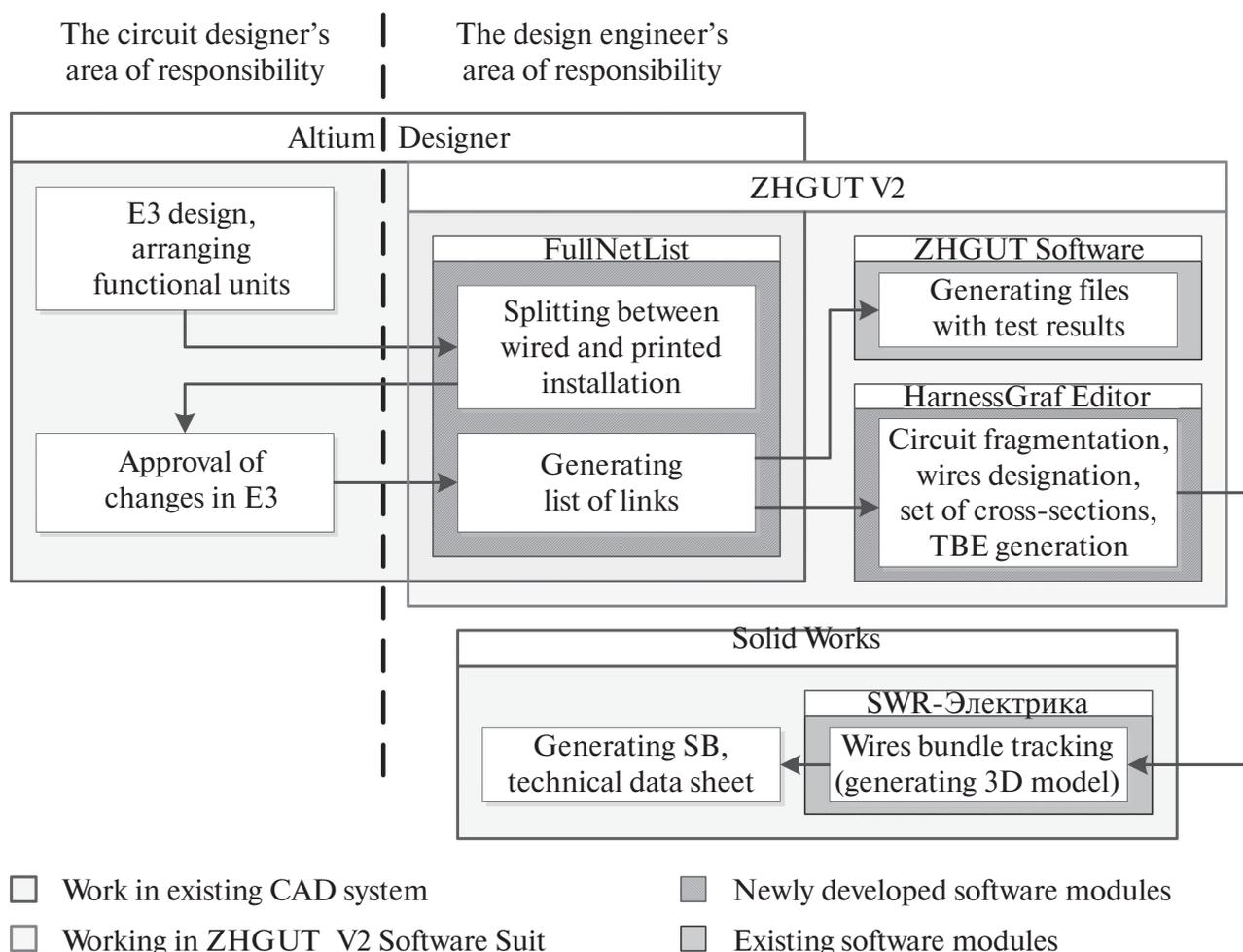


Figure 1. Software Suite «ZHGUT_V2» in the Algorithm of Wired Installation Design of REE
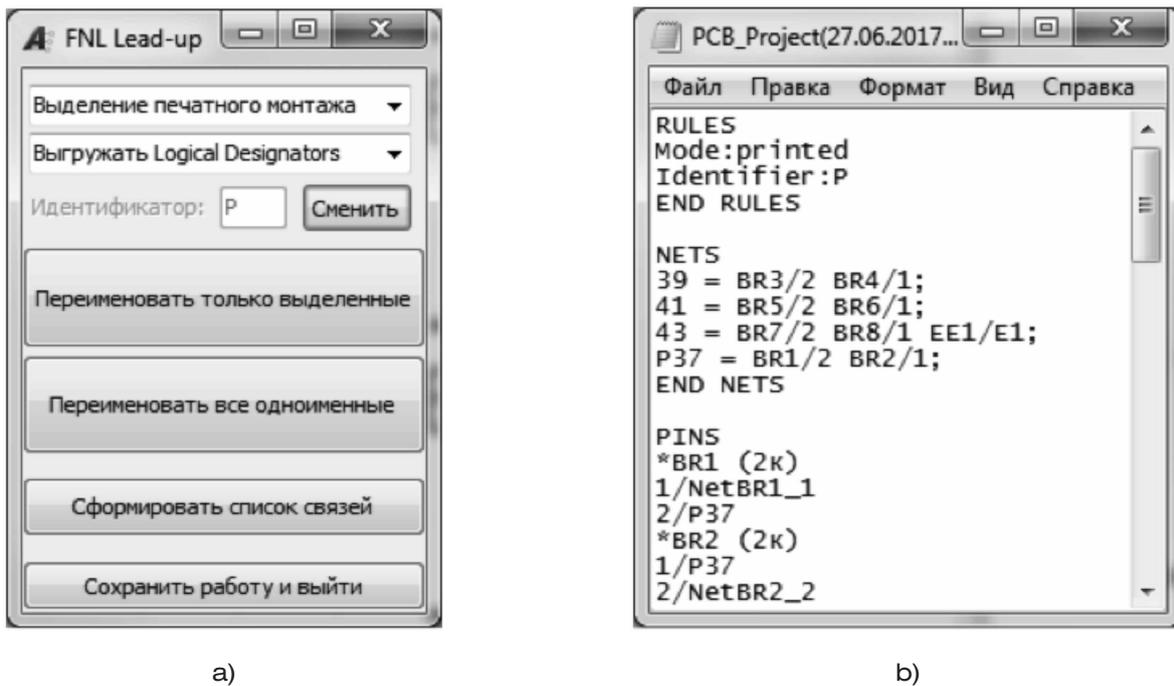
a)

b)

Figure 2. Working with FullNetList module: a – an example of an interface; b – an example of a list of links



Figure 3. An interface example of ZHGUT Software

1. Importing the list of links generated by FullNetList.
2. Automated check of the list of links for circuits and connectors with the same name.
3. Automated determination of circuit attributes (shielding, twisting).
4. Graphic visualization of circuit elements: wires, connectors, contacts.
5. Interactive processing (fragmentation) of electric circuits:

• assigning types, cross-sections, ratios of wires;
• the ability to add fragments as a group;

• automatic computing of electrical circuit closeness based on software implementation of math graph theory;
• the ability of ordering the list of circuits (ordered by the circuit name, the number of addresses etc.);
• the ability to save/load the work done;
• the ability of updating in accordance with the updated list of links.

6. Automated generation of TBE table of connections according to GOST 2.413–72 [3], table of shielded cables, table of connectors wirings.
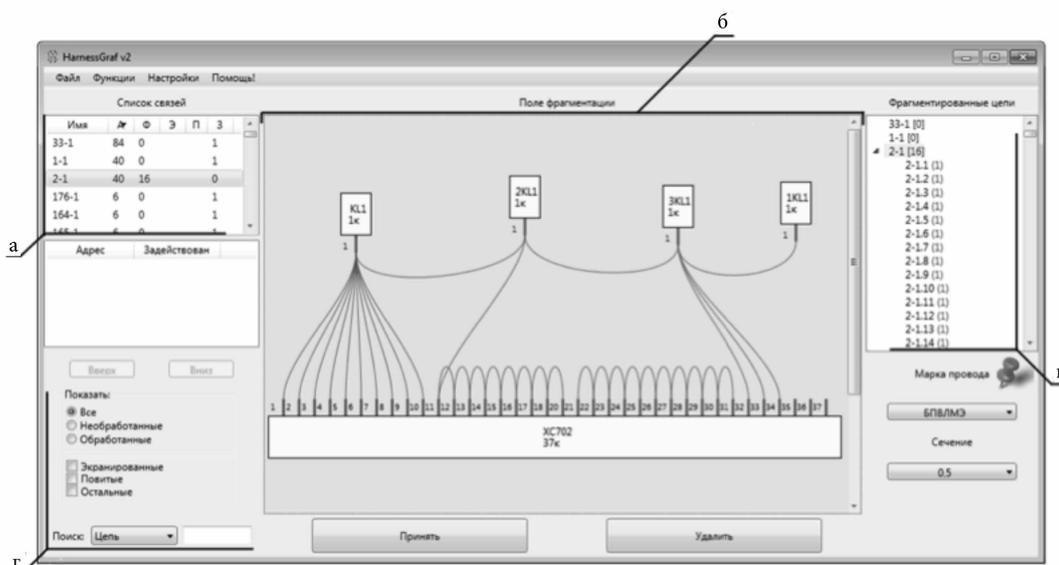
Figure 4. HarnessGraf Module Interface: a – list of circuits; b – visual representation of the selected circuit; c – list of circuit fragments; d – data filtering tools

## 7. Generating the source data for SolidWorkd «SWR-Electrica»

HarnessGraf module interface is shown on Fig. 4. When you select a circuit from the list (Fig. 4a) a visualization of its elements takes place in the field on Fig. 4b. Connector are represented as rectangles with preference designators, separate contacts (addresses) are represented as a thick line section with the designation of this contact and are linked to the corresponding connector. A piece of cable is represented as a spline that connects two addresses. When you drag or rotate a connector the contacts and wires linked to it are dynamically rebuilt.

After the fragmentation process is completed the design engineer assigns the correspondence of each circuit to a certain wire bundle if necessary and gets a table of connections according to GOST 2.413–72. He also gets the table of shielded cables and wiring control table in PDF. Also after the fragmentation is completed you can also get a source data file form importing it into SolidWorks module «SWR-Electrica», where you can automatically lay down wires into the traces that were prepared before (Fig. 5)

The advantages of using ZHGUT_V2 Software Suit:

1. Creating automated end-to-end cycle of designing REE electric installation (automating every step of design work).
2. Decreasing human factor impact (reducing the number of errors during the transferring and recoding information).
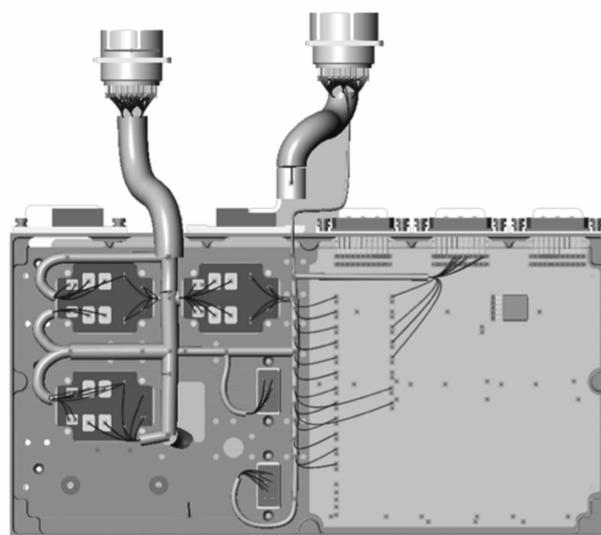


Figure 5. An example of a bundle 3D model on a device load carrying structure, created in CAD SolidWorks «SWR-Electrica»

3. Creating a 3D model of a product with the consideration of wired installation.
4. Automated calculation of lengths and weights of wires with consideration of tolerances and bend radius.
5. Automated generation of table of connections according to GOST 2.413–72.
6 Finding the way to implement promising methods of manufacturing and installation of bundles [4–6]: automated preparation of cables for installation, laying out wire bundles without a drawing by using interactive 3D model.

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