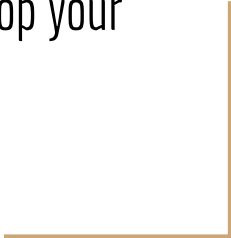


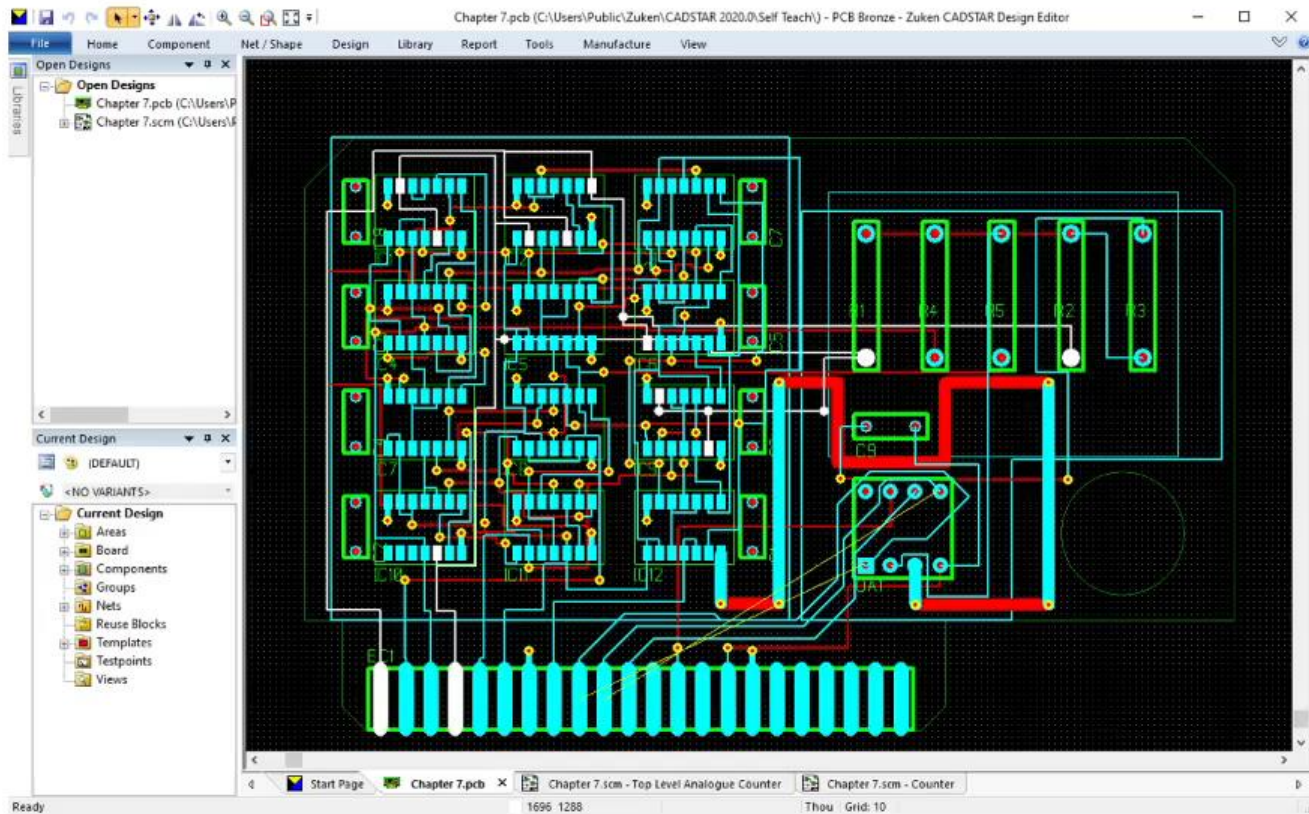


Importing into KiCad from CADSTAR

... and how you can develop your
own importer











CADSTAR™

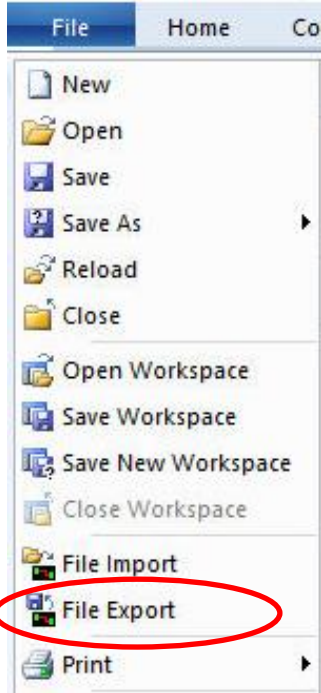


Working File Formats: *.pcb / *.scm

```
1 PCB
2 Data Structure Access Version 2020.0.0.22
3 Format:58
4 Application: CADSTAR Design Editor Version 2020.0
5 Routed
6 SUB {ESTXNUL NULNULNUL%...NULNULNULNULNULNULNULDS_DISPLAYNULNUL
7 NULNULèETXNULNULÿÿÿÿNULNULNULNULNULáõENONULáõENOSOHNULNUL
8 NULNULNUL
9 NULNULNULENONULNULNULNULNULNULNULNULNULNULNULNULNULNULNULNUL
10 NULNULNULVTNULNULNULFEENULNULNUL
11 NULNULNULSONULNULNULSTINULNULNULDIENULNULNULDC1NULNULNULD
12 NULNULNUL
13 NULNULNULENONULNULNULNULNULNULNULFEENULNULNULFEENULNULNULB
14 NULNULNUL
15 NULNULNULENONULNULNULNULNULNULNULNULNULNULNULNULNULNULNULNULB
16 NULNULNUL
17 NULNULNULENONULNULNULSTXNULNULNULNULNULNULNULNULNULNULNULNULNUL
18 NULNULNUL
19 NULNULNULENONULNULNULSTXNULNULNULNULNULNULNULNULNULNULNULNULNUL
20 NULNULNULBENULNULNULNULNULNULNULNULNULNULNULNULNULNULNULNULNUL
21 NULNULNUL
22 NULNULNULENONULNULNULSTXNULNULNULNULNULNULNULNULNULNULNULNULNUL
23 NULNULNULBENULNULNULNULNULNULNULNULNULNULNULNULNULNULNULNULNUL
```

Name	Type
 Design 1.pcb	CADSTAR PCB File
 Design 2.pcb	CADSTAR PCB File
 Design 3.pcb	CADSTAR PCB File
 Design 3.scm	CADSTAR Schematic File
 Design 4.pcb	CADSTAR PCB File
 Design 4.scm	CADSTAR Schematic File
 Design 5.pcb	CADSTAR PCB File
 Design 5.scm	CADSTAR Schematic File

Another path!



Name	Type
Design 5.csa	CADSTAR Schematic Archive File

```
1 (CADSTARSCM
2 (HEADER
3 (FORMAT DESIGN 2 19)
4 (JOBFILE "C:\\Users\\Public\\Zuken\\CADSTAR 2020.0\\Self Teach\\Design 5.scm")
5 (JOBTITLE "Schematics Selfteach Chapter 5")
6 (GENERATOR "SCM to CSA, Version 2020.0.0.25")
7 (RESOLUTION
8 (METRIC HUNDREDTH MICRON)
9 )
10 )
11 (TIMESTAMP 2021 1 9 22 11 1)
12 )
13 (ASSIGNMENTS
14 (CODEDEFS
15 (LINECODE LC0 "(Connections)" 2540
16 (STYLE SOLID)
17 )
18 (LINECODE LC1 "Line 5" 12700
19 (STYLE SOLID)
20 )
21 (LINECODE LC2 "Line 10" 25400
22 (STYLE SOLID)
23 )
24 (LINECODE LC3 "Line 15" 38100
25 (STYLE SOLID)
26 )
27 (LINECODE LC4 "Line 25" 63500
28 (STYLE SOLID)
29 )
30 (LINECODE LC5 "Line 1" 2540
31 (STYLE SOLID)
32 )
33 (LINECODE LC6 "Line 24" 60960
34 (STYLE SOLID)
35 )
36 (LINECODE LC7 "Line 8" 20320
```

Name	Type
Design 5.pcb	CADSTAR PCB Archive File

```
1 (CADSTARPCB
2 (HEADER
3 (FORMAT LAYOUT 2 21)
4 (JOBFILE "C:\\Users\\Public\\Zuken\\CADSTAR 2020.0\\Self Teach\\Design 5.pcb")
5 (JOBTITLE "Placed and Swapped")
6 (GENERATOR "PCB to CPA, Version 2020.0.0.25")
7 (RESOLUTION
8 (METRIC HUNDREDTH MICRON)
9 )
10 )
11 (TIMESTAMP 2021 1 9 22 11 19)
12 )
13 (ASSIGNMENTS
14 (LAYERDEFS
15 (LAYERSTACK LAY24 LAY25 LAY28 LAY27 LAY14 LAY16 LAY18 LAY22 LAY12 LAY20
16 LAY6 LAY29 LAY7 LAY30 LAY8 LAY31 LAY9 LAY21 LAY13 LAY23
17 LAY19 LAY17 LAY15 LAY26 LAY11 LAY10 LAY32
18 )
19 (MATERIAL MTL0 "Copper Foil" ELECTRICAL
20 (RELPERMIT
21 (E 1 0)
22 )
23 (LOSSTANGENT
24 (E 0 0)
25 )
26 (RESISTIVITY
27 (E 175 -2)
28 )
29 )
30 (MATERIAL MTL1 "A-PPE Nelco 6000-21" CONSTRUCTION
31 (RELPERMIT
32 (E 35 -1)
33 )
34 (LOSSTANGENT
35 (E 0 0)
36 )
```

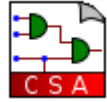
*.cpa High Level File Structure



CADSTARPCB

HEADER	FORMAT JOBFILE GENERATOR RESOLUTION TIMESTAMP
ASSIGNMENTS	LAYERDEFS CODEDEFS TECHNOLOGY GRIDS NETCLASSEDITATTRIBSETTINGS SPCCLASSEDITATTRIBSETTINGS
LIBRARY	SYMDEF SYMDEF SYMDEF SYMDEF ...
DEFAULTS	DFLTSHAPETYPE FILLETRADIUS FIGDFLTS COMDFLTS AREADFLTS ...
PARTS	PART PART PART PART ...
LAYOUT	BOARD AREA COMP NET ...
DISPLAY	COLORS PICKABLECOLORS VISIBLELAYERS BACKGROUND HILITECOLORS ...

*.csa High Level File Structure



CADSTARSCM

HEADER	FORMAT JOBFILE GENERATOR RESOLUTION TIMESTAMP
ASSIGNMENTS	CODEDEFS SETTINGS GRIDS NETCLASSEDITATTRIBSETTINGS SPCCLASSEDITATTRIBSETTINGS
LIBRARY	SYMDEF SYMDEF SYMDEF SYMDEF ...
DEFAULTS	DPLTSHAPETYPE FILLETRADIUS FIGDPLTS COMDPLTS ...
PARTS	PART PART PART ...
SHEETS	SHEET SHEET SHEET ...
SCHEMATIC	FIGURE SYMBOL ... NET ...
DISPLAY	COLORS PICKABLECOLORS VISIBLELAYERS BACKGROUND HILITECOLORS ...

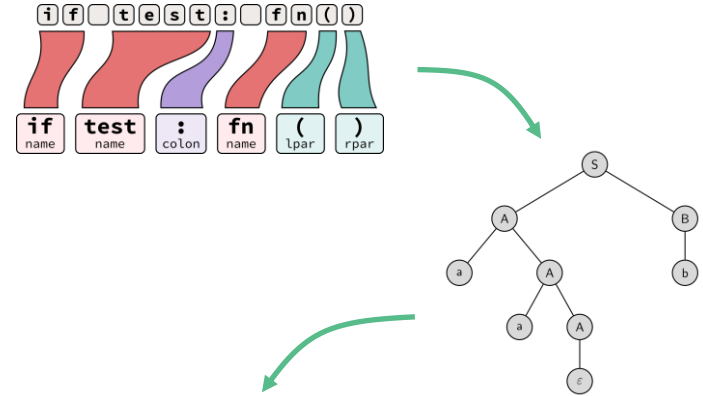
ASCII file import - an approach

Parser

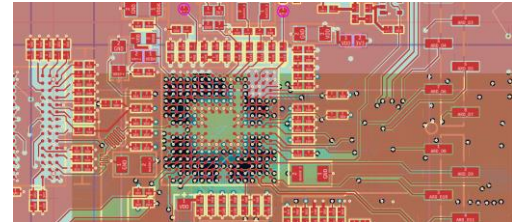
1. Split into **tokens**
2. Create a **document tree**
3. Convert to a **data model**

Loader

4. **Load** data model as KiCad objects



```
struct CPA_FILE
{
    std::vector<VERTEX>      BoardShape;
    std::vector<GROUP>      Groups;
    std::vector<NET>        Nets;
    std::vector<ROUTE_VERTEX> Routes;
    std::vector<FIGURE>    Figures;
    std::vector<AREA>       Areas;
};
```



Step 1: Tokens. S-expression Grammar

```
sexpr ::= (sx)
sx ::= atom sxtail | sexpr sxtail | NULL
sxtail ::= sx | NULL
atom ::= quoted | value
quoted ::= "ws_string"
value ::= nws_string
```

Extract from *.cpa:

```
(LAYER LAY12 "Top silk"
  (NONELEC 1)
  (LASUBTYP LAYERSUBTYPE_SILKSCREEN)
)
```

See: <https://dev-docs.kicad.org/components/sexpr/>

Step 1: Tokens. `class` DSNLEXER

`int` NextTok ()

Return the next token found in the input file or DSN_EOF when reaching the end of file.

```
...
DSN_NUMBER      = -5,
DSN_RIGHT       = -4, // right bracket, ')'
DSN_LEFT        = -3, // left bracket, '('
DSN_STRING      = -2, // a quoted string, stripped of the quotes
DSN_EOF         = -1  // special case for end of file
```

`const char*` CurText () `const`

Return a pointer to the current token's text.

See: <https://docs.kicad.org/doxygen/classDSNLEXER.html>

Step 2: Document Tree. `class XNODE`

`void AddChild (XNODE* child)`

Adds node child as the last child of this node.

`XNODE * GetParent ()`

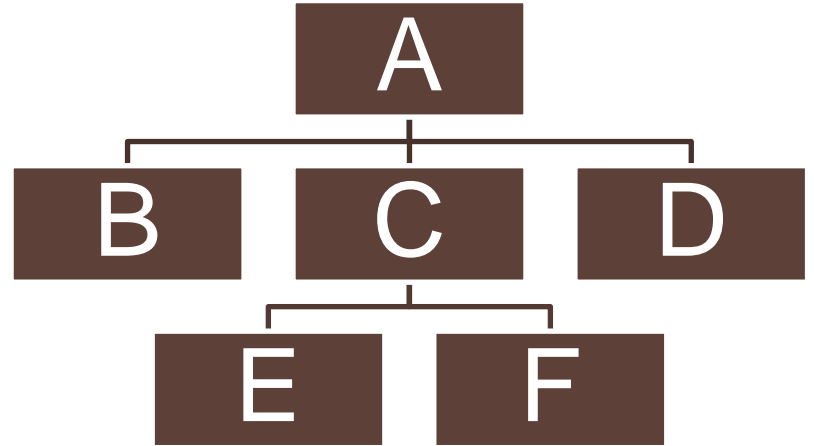
Returns a pointer to the parent of this node or NULL if this node has no parent.

`XNODE * GetChildren ()`

Returns the first child of this node.

`XNODE * GetNext ()`

Returns a pointer to the sibling of this node or NULL if there are no siblings.



Step 3: Data Model. Example: LAYERDEFS

```
(LAYERDEFS
(LAYERSTACK LAY24 LAY25 LAY28 ... )
(MATERIAL MTLO "Copper Foil" ELECTRICAL
(RELPERMIT
(E 1 0)
)
(LOSSTANGENT
(E 0 0)
)
(RESISTIVITY
(E 175 -2)
)
)
...
(LAYER LAY6 "Top Elec"
(ELEC 1
(BIAS Y_BIASED)
(MAKE MTLO 1750
(EMBEDS UPWARDS)
)
)
)
(SWAPPAIR LAY6 LAY9)
...
)
```

```
struct LAYERDEFS
{
    std::vector<LAYER_ID>          LayerStack;
    std::map<MATERIAL_ID, MATERIAL> Materials;
    std::map<LAYER_ID, LAYER>     Layers;
    std::map<LAYER_ID, LAYER_ID>  SwapPairs;
    void Parse( XNODE* aNode );
};
```

Step 3: Data Model. Error Detection `assert` & `throw`

```
void LAYERDEFS::Parse( XNODE* aNode )
{
    wxASSERT( aNode->GetName() == wxT( "LAYERDEFS" ) );
    XNODE* cNode = aNode->GetChildren();

    if( !cNode )
        THROW_MISSING_PARAMETER_IO_ERROR( wxT( "LAYERSTACK" ), wxT( "LAYERDEFS" ) );

    for( ; cNode; cNode = cNode->GetNext() )
    {
        wxString nodeName = cNode->GetName();

        if( nodeName == wxT( "LAYERSTACK" ) )
        { /* Parse LayerStack */ }
        else if( nodeName == wxT( "MATERIAL" ) )
        { /* Parse Material */ }
        else if( nodeName == wxT( "LAYER" ) )
        { /* Parse Layer */ }
        else if( nodeName == wxT( "SWAPPAIR" ) )
        { /* Parse SwapPair */ }
        else
        { THROW_UNKNOWN_NODE_IO_ERROR( nodeName, aNode->GetName() ); }
    }
}
```

Step 4: Loading. PLUGIN::Load

```
class CADSTAR_PCB_ARCHIVE_PLUGIN : public PLUGIN
{
    [...]

    BOARD* Load( const wxString& aFileName, BOARD* aAppendToMe,
                 const PROPERTIES* aProperties = nullptr, PROJECT* aProject = nullptr ) override
    {
        m_board = aAppendToMe ? aAppendToMe : new BOARD();

        [...]
    }

private:
    BOARD* m_board;
}
```

Step 4: Loading. Example: Tracks

EAGLE Importer

```
TRACK* t = new TRACK( m_board );

t->SetPosition( start );
t->SetEnd( end );
t->SetWidth( width );
t->SetLayer( layer );
t->SetNetCode( netCode );

m_board->Add( t );
```

From: https://gitlab.com/kicad/code/kicad/-/blob/master/pcbnew/plugins/eagle/eagle_plugin.cpp#L2349-2357

Altium Importer

```
TRACK* track = new TRACK( m_board );
m_board->Add( track, ADD_MODE::APPEND );

track->SetStart( elem.start );
track->SetEnd( elem.end );
track->SetWidth( elem.width );
track->SetLayer( klayer );
track->SetNetCode( GetNetCode( elem.net ) );
```

From: https://gitlab.com/kicad/code/kicad/-/blob/master/pcbnew/plugins/altium/altium_pcb.cpp#L2207-2214

Step 4: Loading. Example: Tracks

CADSTAR Importer

```
for( PCB_SHAPE* ds : aDrawsegments )
{
    TRACK* track;
[...]
```

```
    track = new TRACK( aParentContainer );
    track->SetStart( ds->GetStart() );
    track->SetEnd( ds->GetEnd() );
[...]
```

```
    track->SetWidth( ds->GetWidth() );
[...]
```

```
    track->SetNet( aNet );
[...]
```

```
    aParentContainer->Add( track, ADD_MODE::APPEND );
}
```

Adapted from: https://gitlab.com/kicad/code/kicad/-/blob/master/pcbnew/plugins/cadstar/cadstar_pcb_archive_loader.cpp#L2531-2586

Develop your own importer!

1. Join the Developers Mailing List
2. Write minimal code to trigger the import
3. Open a merge request
4. Ask questions!

KiCad Developers Mailing List: <https://launchpad.net/~kicad-developers>

CADSTAR Importer Statistics

Parser:

- Common (*.cpa &*.csa): ~3800 lines
- PCB (*.cpa): ~3800 lines
- Schematic (*.csa): ~1500 lines

Loader:

- PCB (*.cpa): ~3700 lines
- Schematic (*.csa): ~2300 lines