DynTFTCodeGen

-VCC-
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1. Introduction

DynTFTCodeGen is a tool, used for designing and generating initialization code and event handlers for DynTFT projects. It features a drawing board, an object inspector, a component palette and various dialog boxes for application and project level settings.

[Parts of the application, or other components can be named differently across this documentation, like "ObjectInspector", "Object Inspector", "Object inspector", "object inspector". It is similar for other descriptions like "Designtime", "Design time", "Design-time". They refer to the same thing. This is mostly for readability.]
The following introduction sections mention various parts of the application, which should be described later in other chapters of this documentation.

1.1 Features

- Component properties can be edited using an object inspector. Event handlers are also included.
- Components can be locked, so their position and size can't be accidentally changed. When a component is locked, it can't be dragged/moved or resized on the drawing board.
- Ability to preview the design using a color theme (.dyncol file) - see limitations below.
- Components are organized using screens, so they wouldn't be displayed all at once.
- Components belonging to a particular screen, can be set to be visually persisted across all screens (design-time only).
- Ability to drop on the drawing board, components which are usually part of other components, that do not work on their own: Items, RadioButton, TabButton, KeyButton, MessageBox.
- Component properties are organized in two categories: Runtime and Designtime. Runtime properties are found in component type definition, while Designtime ones are used for editing only.

1.2 Known issues

- Components are flickering when moved or resized on the drawing board.
- Can't properly move/resize a component while scrolling with the mouse wheel
- On particular OS setups, the application can display "Cannot focus a disabled or invisible window." after starting.
- Sometimes, after closing the application, it can keep a CPU core to the maximum (not sure

how to reproduce). This was encountered a few times during development, so it might be related to test builds only.

- When manually removing component registration from a component, in Project Settings window, it automatically removes its dependencies, no matter they were set as dependencies of another component or not. The generated code should not be affected.

- Small memory leaks. As a rough estimate, opening a project with 512 panels, the application is reported to use 12.5-12.8MB in TaskManager (2.5MB, started fresh, without any project). After a few cut-paste operations of all panels, the memory usage increases to 18MB (about 1KB / cut-paste of all panels). Since this is not much when working with a "normal-sized" project, in-depth analysis was deferred to a future version.

1.3 Features, not bugs

Some parts of the application may behave a bit differently than expected. This is by design, either to optimize operations or to keep implementations simpler. Others might be considered incomplete implementations.

- Copying components using keyboard shortcuts, requires the drawing board to be focused (mouse over drawing board). This depends also on a setting to automatically focus the drawing board when being hovered with the mouse. If that setting is off, users will have to click on one or more components to focus the drawing board, prior to the copy operation.

- Ctrl-A selects only those components from current screen. Use Ctrl-Shift-A for all screens.

- Components are hidden while pasting or selecting (for a faster operation). Users may notice that components are hidden for a few milliseconds. Pasting requires new components to be created, so setting their position and size would require additional painting operations. Being hidden, some of these operations are skipped.

- Copy-paste operations do not include screen size. Only components are copied.

- When pasting components (all copied from the same screen), they are pasted in the current screen, regardless of their ScreenIndex property.

- When dragging multiple selected components, towards 0 (either left or top), their relative position changes as they are constrained to the visible area. Since there is no undo operation, this can be cancelled by right-clicking while the left mouse button is still down.

- Property values, which depend on compiler directives, are displayed in red in ObjectInspector

- When starting to drag a component, the component won't move for the first 5px (configurable) of mouse movemen in any direction. This is to prevent accidental moving on MouseDown. Hold Alt key while dragging, to temporarily disable this feature.

1.4 Limitations

- There is no information about used memory of the DynTFT components, at design time. Please use a simulator, as provided in DynTFT examples.

- There is no live drawing for VirtualKeyboard (colors are set to default). It has fixed size. This is because of the internal complexity of this component. Since there is no pointer to each key button, the keyboard relies on the internal structure of DynTFT to keep track of all its buttons. DynTFTCodeGen does not use that structure, so it would require a different mechanism of keeping track of all these buttons.

- No Unicode support.

- No zoom support.

- No undo/redo support.

- Although Object Inspector and Component Palette can be resized, they can't be moved.

- Many things are hardcoded, so there is no support for user-defined components. Although parts of the application allow customization, it was not implemented for adding new components.

- Runtime Z order may not always match design-time Z order. Most of the time, components should not be overlapped. More than that, there are some components (e.g. DynTFTComboBox, which bring some of their parts to front, on run time, changing design-time Z order).

- Components can only be brought to front or sent to back.

- Not all constants are available in ObjectInspector as choices for a particular property. Constants are displayed based on their data type.

- Some enum-like properties (e.g. ArrowDir, Direction, Orientation etc) are allowed to be set to all available constants of a component.

- Displayed components are not transparent, so if overlapping, they may look a bit different on simulator and hardware.

- Schema files are not validated, so expect crashes or bugs if manually edited.

- Components don't snap to a grid or to each other. Use the "Lock" property to avoid moving them accidentally.

- Property values are not displayed in bold in ObjectInspector, if different than defaults.

- Adding new tabs to a page control, or new radio buttons to a radio group can be done only by using their "Items" property. There is no special pop-up menu for these components.

- Unknown component properties are ignored when loading a project. They are discarded on save. The same for copy-paste. This may be encountered when having two or more instances of DynTFTCodeGen, installed in multiple different locations, each with its own set of different schema files.

- Changing direction/orientation of a ScrollBar, TrackBar or ProgressBar, does not automatically swap their Width and Height values.

- Switching from one component to another on the DrawingBoard does not automatically select the last focused property in ObjectInspector.

- The icon order in component Palette is hardcoded. Icons are also built-in.

- Colors from color themes, are not embedded in projects. They have to be manually loaded when needed. Color themes will have to be managed separately for each DynTFT project.

- When pasting components leads to duplicate names, only the object names are modified. Captions are kept.

- When pasting components from multiple screens, the current screen is not changed, but the paste operation succeeds.

- No built-in simulator. Users will have to manually rebuild their project simulators after every code generation.

- Double clicking on properties in ObjectInspector, is not implemented for all property types.

- Double clicking on events in ObjectInspector starts a 200ms timer to automatically create a new handler. The double click action has to be faster than 200ms, to create the handler.

- Double clicking on a component does not generate an event handler. Use the ObjectInspector.

- No support for vertical text orientation. This is a limitation of DynTFT library.

- The height of items (see ItemHeight property) of the Items component, has to be manually adjusted according to used font. The same for button height on PageControl.

- Empty RadioGroups and PageControls will generate uncompilable code. Always have at least one button. If manually creating buttons at run time is desired, either use a RadioGroup/PageControl with a button and remove it dynamically, or manually create the RadioGroup/PageControl at run time.

- Project file name is added to generated files, to warn users about overwriting with a different project. If there are two projects with the same name in different locations, no warning is given. Also, the project name is verified from DynTFTGUI.pas only.

- Handler names are verified as case sensitive. If renamed to a different case, they are added as new handlers. Old handler headers will have to be manually removed. The same for parameter list of these handlers, which have to match definitions from Schema files. If they don't match, new ones are created.

- Unused/unassigned event handlers are removed from a DynTFTCodeGen project, only when closing the project. If they appear in generated code, they have to be manually removed.

- Handler implementation is added based on new added handlers with regard to existing handler headers in the generated file. If their implementation is manually removed, the new implementation is re-added, only if adding new handlers or removing their headers from the interface section of the DynTFTHandles.pas unit.

- Properties are organized into Runtime and Designtime categories in ObjectInspector. They are sorted by name in each category. That can't be changed.

- Some property names are hardcoded into application, like "ObjectName", "ScreenIndex", "Left", "Top", "Width", "Height", "CreatedAtStartup", "HasVariableInGUIObjects", "Locked", "ActiveFont" etc. Do not rename them in schema files, as the application will become unusable.

- Not all properties / data types are constrained in ObjectInspector. Be careful about what you input. Integer properties accept string values, to allow user-defined constants to be used. This is to allow assigning variables, constants, functions etc to a property, ar runtime, which DynTFTCodeGen should not know about. However, properties like "ObjectName", "ScreenIndex", "Left", "Top", "Width", "Height" are required by DynTFTCodeGen, and have to be assigned to constants at designtime.

- In ObjectInspector, properties of array type (e.g. "Strings", "Items^.String", "AllButtonsWidth" etc) display their values in a single line, without any blank between values. An items editor is available to edit such properties.

- Object names are not validated against existing event handler names or viceversa. Name collisions will be detected on compiling the DynTFT project.

- When the template files are changed (*.txt files from the OutputParts directory), for the handlers file, the changes have to be manually applied. This is because DynTFTCodeGen either generates this file from scratch or adds code to it, but does not keep it in sync with template files.

- When there are components for which no property is set and all of them are configured to have no variable in DynTFTGUIObjects file, a local variable is generated and left unused after assignment. This will cause a compiler notification about unused variables. The limitation comes from the Schema files, which only support one type of implementation, assuming that components will be customized and at least one property will have a value different than default.

- Although DynTFTCodeGen projects contain the list of available components, if loading a project in a DynTFTCodeGen instance, which has a different list of available components, the project may not be loaded properly.

- DynTFTCodeGen can work with up to 255 screens and will generate code for them. It does not take into account the number of screens the library supports. See *CDynTFTMaxComponentsContainer* constant from DynTFTTypes.pas unit.

- The colors used at design-time are 32-bit only. The code generator handles both 32-bit and 16-bit colors when generating output files. See Project Settings for options.

- DynTFTCodeGen does not control the color theme used by a project. The color theme has to be manually included in a DynTFT project, using the DynTFTColorTheme.inc file.

- There is no option to limit the number of recent files. If really needed, the DynTFTCodeGen.ini file can be edited using a text editor.

- DynTFTCodeGen does not manage DynTFT projects. Compiler directives, like *DynTFTFontSupport* have to be manually added to projects (Project Settings in Delphi/FreePascal and .pld files in mikroPascal). The same for extra units, e.g.: ExternalResources.pas, added in DynTFTGUIAdditionalUnits.inc.

1.5 FAQ:

- Q: Does DynTFTCodeGen backup the projects it saves?

- A: No, it does not backup projects. It is recommended to use a version control software and keep track of as many changes as possible. It does create backups of the generated DynTFTHandlers.pas file, because it is expected that users edit this file using a source code editor.

- Q: When I copy the value of a property from one component, then paste it to another component, why does it set its value to "[SelectionInfo]"?

- A: The "[SelectionInfo]" string is part of the copy-paste format content when copying components. This indicates that a component was focused when pressing Ctrl-C, not the Object Inspector. Make sure not to move the mouse cursor outside Object Inspector when copying a property value. Also, see Application Settings for options about focusing the drawing board.

- Q: How do I add my custom component to the application?

- A: As mentioned in the "Limitations" section, there is no proper support for that. The application statically depends on DynTFT to draw components. You can add your schema file to the "\Schemas" directory and add an entry to DynTFTCodeGenInstalledComponents.ini, but there would be no drawing for the new component. Automatic design-time calculations won't be possible either (e.g. see the ItemHeight property of a RadioGroup).

- Q: Why the property for the name of a component is called "ObjectName" and not "Name"?

- A: "Name", if implemented, should be a runtime property and it wouldn't be practical to ensure it is unique. It may be useful mostly for debugging.

- Q: Why the property for font is "ActiveFont" and not simply "Font"?

- A: ActiveFont is a pointer to font information. It is unpractical to store the entire description of a font in a property, so a different name makes more sense.

- Q: Out of the four generated files, which one can be manually edited using an external editor?

- A: Only DynTFTHandlers.pas can be manually edited, so users can add code to the pregenerated handlers. The other three files (DynTFTGUI.pas, DynTFTGUIObjects.pas and DynTFTFonts.pas) are completely regenerated.

- Q: How to swap two screens or move a screen to a different index?

- A: Hover the tab buttons of the list of screens with the mouse, hold the Ctrl key and start scrolling with the mouse wheel.

- Q: Can the settings of the default font be changed?

- A: Yes, just add it to the list in the Project Setting dialog, then change the settings. This is useful when using a custom TFT library.

- Q: If the generated code is smaller and less RAM is used when the "HasVariabileInGUIObjects" property is set to false for most components, why isn't this the default value?

- A: It is easier for users to find a component by its object name. For components which generate an event and have an assigned event handler, the Sender parameter of the handler can be used to get a pointer to that component. They can have the "HasVariabileInGUIObjects" property set to False. It requires typecasting though.

- Q: Where should I look first, if something behaves different than expected?
- A: There are general application settings and project-level settings, found under the Tools menu. In addition to that, there are screen options under the Screens pop-up menu. There are also various design-time component properties, which configure component behavior. Hints will pop up all over the application. Unfortunately, not all features are configurable.

- Q: What should I do if I find a bug?
- A: Before reporting a bug, please see if it is already mentioned in one of the "Known issues", "Features, not bugs" or "Limitations" sections above. Do not send me or publicly post projects (*.dyntftcg files), as they might contain information you don't want to give away. If a minimal project is required to report a bug, please open it using a text editor, and look for stuff you might want to remove. When reporting a bug, it is desired to mention the steps used to reproduce the bug, by having the first step as "open the application", followed by "click here", "click there"-like steps. Also, if a project is already corrupt (either by DynTFTCodeGen or manually edited using a text editor), it has no value in reproducing a bug, because the application is not designed to handle corruptions. However, it is very useful to have the steps about how a good project can be corrupted by the application. If you are editing schema files, bug reports may have little value, because these are not validated, so the application may not work properly.

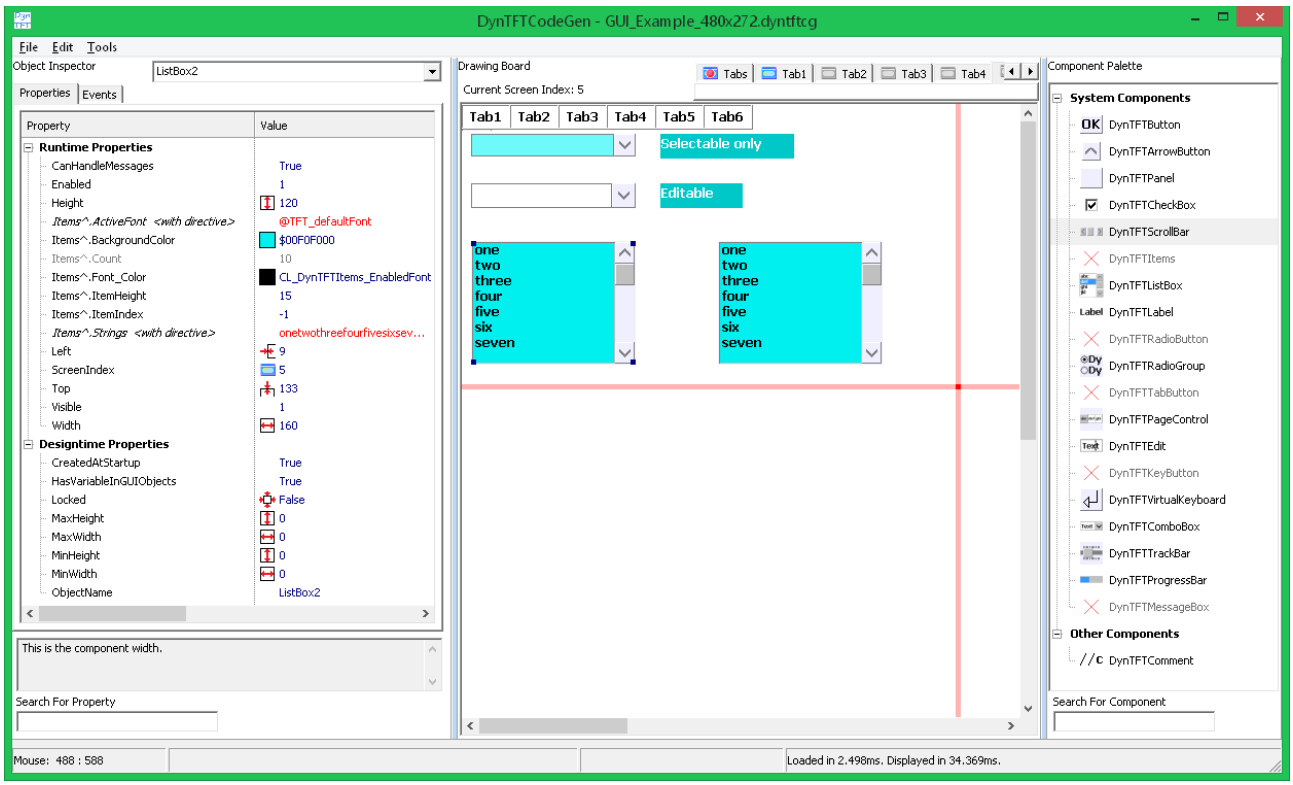
- Q: Can I use an already existing DynTFTHandlers.pas file in a project in which DynTFTCodeGen generates this file?
- A: Yes, if the code generation symbols are manually added on functions/procedures (also notice the difference //CodegenSym:header vs. //CodegenSym:handler) and the headers match the string format that comes from schema files. Probably, the easiest way is to let DynTFTCodeGen generate an empty file, then you can add your code to it.

- Q: Can I use "OnClickUser" event on components?
- A: At the moment of writing this, DynTFT library does not implement this event. Please use "OnMouseUpUser" event.

1.6 Application overview

DynTFTCodeGen is a simple application, with a main window and a few configuration windows. From the component palette, with currently implemented DynTFT components, users add components to the drawing board, by dragging them. They can be moved or resized on the drawing board, either by mouse or by keyboard. Various properties and event handlers can be set from the object inspector.

Components are organized into screens, so they won't be displayed all at once. Screens can be active or inactive, and persisted or not persisted. Active screens match the "Active" field of the "TDynTFTScreenComponentInfo" field, which controls which components to be painted, based on their "ScreenIndex" property/field. There are cases when users want components from a particular screen to be visible across all screens. For this, screens can be set to be persisted, so their components will be visible regardless of the current selected screen. For example, in the following screenshot, the first screen, called "Tabs" is set to persisted (notice the red pin icon over the (blue) screen icon), so the PageControl (the top most visible component on the drawing board) is visible, although the current screen is set to "Tab5". This is the intended behavior at run time, when this PageControl belongs to an active screen (at index 0), and is used to activate / deactivate the other screens. When changing current screen, components are hidden and displayed, based on their "ScreenIndex" property.



The Object Inspector is a key–value list (or property name – property value list), with all available properties of a component, defined by the schema files. It also features a property description box. Based on their data type, properties can be modified from the Object Inspector by various local editing components (Edit, ComboBox, ColorBox) or an items editor in case of array-like properties.

The main menu is kept simple, featuring File, Edit and Tools. There are also pop-up menus for drawing board, screens and components. The File menu is used for opening and saving projects, the Edit menu is organized into component and screen operations, while the Tools menu contains operations like application settings, project settings, loading color theme and generating code.

2. Included files

The application comes as a single executable, *DynTFTCodeGen.exe*, with various configuration files. It uses two ini files: *DynTFTCodeGenInstalledComponents.ini* and *DynTFTCodeGen.ini* . The first one is only loaded by the application, and it contains the list of component names. The other is loaded at startup and saved on close, and is used for general application settings. It is expected that both files are in the same directory as the executable.

If users want to install DynTFTCodeGen in a directory with restricted write permissions, like Program Files, the application would require to be started as Administrator, to be able to write to its *DynTFTCodeGen.ini* file. To avoid starting it as administrator, users can manually create a third ini file, called *DynTFTCodeGenIniOverride.ini* and place it in the same directory as the executable. This file should contain the path to *DynTFTCodeGen.ini*. Thus, *DynTFTCodeGen.ini* can be loaded from and saved to a directory without special write permissions.
In this case, *DynTFTCodeGenIniOverride.ini* should have the following structure:

```
[IniOverride]
Filename=Path\To\DynTFTCodeGen.ini
InstalledComponentsFilename=Path\To\DynTFTCodeGenInstalledComponents.ini
```

In the current version, the application does not save the *DynTFTCodeGenInstalledComponents.ini* file, but allows it to be loaded from a different location.

Schema files are found in the "\Schema" directory, relative to the executable. These files describe the available installed components. They contain the list of properties, events, constants and code templates for code generator. There is a common schema file (*BaseSchema.dynscm*), which contains properties, events and constants for all the other components. They roughly match the fields from the "TDynTFTBaseProperties" structure in *DynTFTypes.pas* file of the DynTFT library.

Base properties from *BaseSchema.dynscm*, can be overridden in component schema files, for further customization. Schema files are also the place where properties are configured as run-time or design-time properties. As mentioned in the previous chapter, new components can be added by creating new Schema files and adding them to the *DynTFTCodeGenInstalledComponents.ini* file, but, they will neither have a drawing on the Drawing Board, nor an icon in the palette. Schema files are loaded once, at application startup.

OutputParts files are common sections of the generated files. They can be found in the "\OutputParts" directory near the executable. OutputParts files are loaded at every code generation. For now, the *DynTFTFonts.pas* file is completely generated without OutputParts files.

3. Component Palette

This part of the application's main window, displays the available components that can be worked with. Its content is described in *DynTFTCodeGenInstalledComponents.ini* file, and by default, it consists of 20 components, organized into two categories: "System Components" and "Other Components". Out of the 19 available system components, five are marked as "Do not use", because they are not designed to be standalone in a DynTFT project. They can be found by a red x icon next to them. Although unusable as standalone, they can be placed on the drawing board, for preview purposes. Except the DynTFTMessageBox component, if placed on the drawing board, all of these "Do not use" will cause the application to generate code in the output files, which should be perfectly fine.

In the "Other Components" category, there is a DynTFTComment component, which is configured not to generate code for the output files. It is a design-time component and it can be placed as much as needed on the drawing board. It can be configured to use custom fonts and colors.

To place a component on the drawing board, simply drag it from Component Palette. In case the component a user is looking for, is difficult to spot, there is a search box, below the list of components, which can be used to search for a component by its name.

4. Drawing Board

All components end up on the drawing board, to be placed into position and resized as needed. The drawing board allows components to be moved, resized, selected, copied, cut, pasted and deleted. Using the keyboard, components can be moved by holding the Ctrl key and pressing one of the arrow keys. For fast moving, also the Shift key has to be held, together with the Ctrl key. For resizing, only the Shift key has to be held, while pressing the arrow keys. As mentioned in the "Limitations" section from the Introduction chapter, components do not snap to a grid or to each other. There are however, alignment "guide" lines, which appear when one or more components are aligned to other components, during moving or resizing. They indicate top to top, left to left, right to right or bottom to bottom alignments.

The selection can be done by mouse, or by keyboard. When selected using the mouse, components from multiple screens can be added to selection, by holding either Ctrl or Shift keys

while clicking on components. There is no difference between these keys when selecting. Both are used identically for convenience. When done by keyboard, there are two shortcuts, Ctrl-A and Ctrl-Shift-A, to select all components. The first one is used to select components from the current screen, while the other selects all components across all screens.

On the drawing board, components have a pop-up menu, which allows cutting, copying, deleting and bringing them to front or sending them to back. The drawing board itself has its own pop-up menu, which allows pasting components from clipboard and selecting all components. The copy-paste operation uses a text clipboard format, which allows these operations across multiple instances of the application. As a restriction, the drawing board has to be focused when copying using the Ctrl-C keyboard shortcut. The application is configured by default to focus the drawing board when hovered with the mouse. Unfortunately, there is no indication when it is focused or not.

Also from the drawing board, the screen size is configured, by dragging the two red bars. For fine tuning, these screen edges can be moved using the arrow keys on the keyboard, while holding them with the left mouse button. For now, their color is not configurable and they can't be hidden. However, they can be locked using their pop-up menu. The screen size, configured by these two bars, does not directly configure the screen size in a DynTFT project. They have to be manually matched. The screen size is set by default to 480x272 and this is a project-level setting.

5. Object Inspector

When one or more components are selected, the object inspector is populated with component properties, based on the current selection. This is where component properties and event handlers can be set. Properties are organized into two categories, design time and run time. In both sections, there are properties which come from the base schema file and properties which are component related. Some property names are hardcoded into application and expected to exist. These include "ObjectName", "ScreenIndex", "Left", "Top", "Width", "Height", "CreatedAtStartup", "HasVariableInGUIObjects", "Locked", "ActiveFont", "MinWidth", "MinHeight", "MaxWidth", "MaxHeight", "Count", "AllButtonWidths", "AllButtonLefts", "PageCount" etc.

5.1 Object Inspector overview

The run time properties, match the available fields in a component's data type structure, by name. More than that, there are run time properties, which match fields from subcomponents. This is to allow code generation by property name, even for subcomponents. As a downside, selecting two components, with a common property, where one is a property of a subcomponent, will end up hiding both, because of the name prefix. For example, the DynTFTItems component has an "ActiveFont" property. This is also displayed on a DynTFTListsBox as "Items^.ActiveFont". Because of the "Items^." prefix, when selecting both components, these properties will not be displayed on the object inspector.

The design time properties are the ones which are not part of the component's data type structure, but control the behavior while designing and generating code.

When placing a new component on the drawing board, its properties are initialized to their default values, as defined in the schema file of that component. If a run time property is modified by user, then assignment code for that property is going to be generated. This is also the case for indirectly modified read-only properties (see below).

Some of the property values are validated at design time, to avoid generating uncompilable code. Others are left unvalidated on purpose, to allow the freedom of assigning everything the user wants. Based on their datatype and name, some properties have different local editors (Edit, ComboBox, ColorBox). For those which use combo boxes or color boxes, they come preloaded with a list of available constants. Unfortunately, these constants are not grouped, like values of an

enumeration, so all of them will be displayed in the same list.

Although useful, the application does not validate string length or number of items of a property. When a string property contains a value, longer than what the field of the DynTFT component data structure allows, it will generate a compilation warning, like: "String constant truncated to fit STRING[19]". Users will have to keep track of these warnings and prevent such cases, to not allow memory corruption on the microcontroller application.

5.2 Common properties

The "ObjectName" property defines the name of the DynTFT component at code generation and has to be unique, because all of these names will become variables, part of the same namespace. The variables, pointing to the actual DynTFT components at run time, are generated in the *DynTFTGUIObjects.pas* file. For components, which have no properties to be set in the DynTFT project at run time, by the user code, there is an option for skipping generating a variable in the *DynTFTGUIObjects.pas* file. This is controlled by the "HasVariableInGUIObjects" property. When set to False, a local variable is generated in the associated "CreateGUI_Screen" procedure from the DynTFTGUI.pas file. Most of the times, this results in smaller flash and RAM usage for the microcontroller application. If no property is set for such a component, none of its fields will be set in the "CreateGUI_Screen" procedure, so a variable will be generated and cause a compiler notification, for being assigned but not used further.

When the "CreatedAtStartup" property of a component, is False, no code is generated for that component, although present on the drawing board. This is to allow users to create that component manually when needed and preview how it will look like. As a limitation, the initialization / component content code is still generated in *DynTFTGUI.pas* file, and not available in *DynTFTGUIHandlers.pas*.

The "Locked" property controls the editing of position and size of a component, at design time. When set to True, the component can't be moved or resized. However, the component can be cut and pasted to a different location even when locked.

The "ActiveFont" property allows setting a different font to a component. The "ActiveFont" field of a DynTFT component data structure, is available only when the "DynTFTFontSupport" compiler directive is present in the DynTFT project, and only for components which display text. Because it depends on compiler directives, the property name is displayed in italic and has the "<with directive>" suffix in object inspector. Also, its value is displayed in red. By default, it is set to "@TFT_defaultFont". To set a new font, it must be first created in the Project Settings dialog (see "Tools" item of the main menu). After creating the new font, it will be available in the selection list of the "ActiveFont" property in object inspector. Notice the "@" used in front of the font constant name. This is because the generated code contains this value, unmodified. When the "UseExternalFont" compiler directive is defined in a DynTFT project, the "TFT_Set_Ext_Font" function is used, so the value of "ActiveFont" properties might have to be set to a value without "@". There is no automatic switching between these two options and DynTFTCodeGen does not keep track of the "UseExternalFont" compiler directive. This property might be present with a suffix in object inspector, if it is part of a subcomponent.

Using the "MinWidth", "MinHeight", "MaxWidth", "MaxHeight" properties, the size of a component can be constrained at design time. When these properties are set to 0, they have no effect.

Other properties like "Count", "AllButtonWidths", "AllButtonLefts", "PageCount", are component specific and are modified/updated by the application, either at design time or at code generation. They are set to read-only in their schema files, to avoid being used at design-time. For example, the "AllButtonWidths" property is a list of integers with the "Width" values of all buttons from a PageControl. It is internally updated, based on the component configuration. Properties like these are required at code generation when there is custom initialization code in the schema files.

5.3 Editing event handlers

Event handlers can be edited from the second tab of the object inspector. By double clicking in the "Value" column, for a particular event, a new event handler name will be generated. Based on their datatype (handler header definition), multiple events can be assigned to the same handler. The available list, when adding or modifying a handler may contain handler names, which are not assigned. They will be discarded when closing the project. However, when generating the output files, these unassigned handlers will also be generated and will have to be manually removed if not needed. They are not automatically removed, because users may want to assign them manually for dynamically created components.

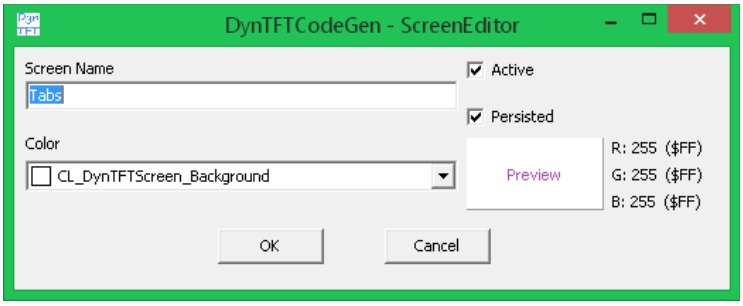
6. Screens

As mentioned before, components are organized into screens, so they won't be displayed all at once. Screens can be added, removed and edited either from the pop-up menu of the list of screens (the tab buttons above the drawing board on the main window) or the "Edit"->"Screen" items of the main menu. Also from here, screens can be set to Active/Inactive and "Persisted/Not persisted. A component, belonging to a screen can be easily moved to another screen, by modifying its "ScreenIndex" property in object inspector. This is available at design time only for now.

The active/inactive setting of a screen is used at application startup in a DynTFT project, as an initialization value for the "Active" field of the "DynTFTAllComponentsContainer" array (see "SetScreenActivity" procedure in a *DynTFTGUI.pas* file).

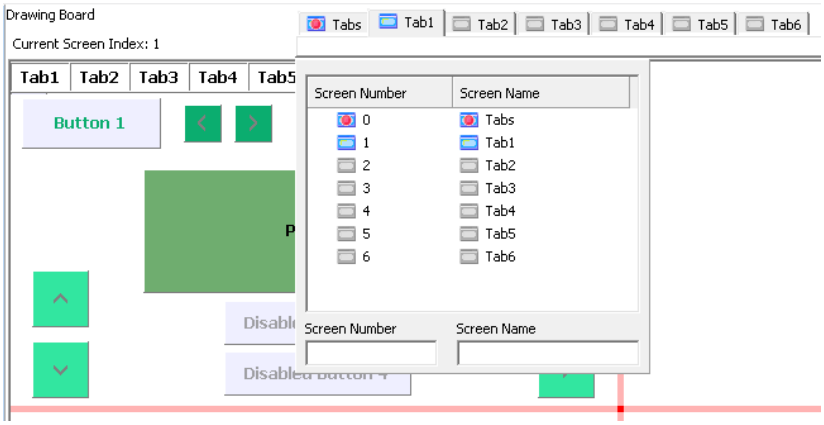
The "Persisted" setting allows displaying components of one screen when other screen is currently selected. This is a design time setting only.

Screens can have a background color and be set to draw a "clear screen" rectangle at application startup. In addition to the "Active" and "Persisted" settings, the screen editor, displayed in the following screenshot, also allows setting the screen color. This screen color is also used at run time when dynamically deleting components or repainting different areas of the screen. The color can be set to one of the predefined colors or to a DynTFT color constant. Setting to a DynTFT color constant, the screen color is automatically updated when a color theme is used.



For applications with many screens, DynTFTCodeGen allows searching for a particular screen by its name. This is available either from the pop-up menu of the screen, or the main menu. By clicking the "Search for screen..." item, a small pop-up dialog opens, with a list of screens and two search boxes (see the following screenshot). Users can type in either the screen number or the screen name. To go to the desired searched screen, just double click on one of the items in the list. This will change the current screen and dismiss the dialog.

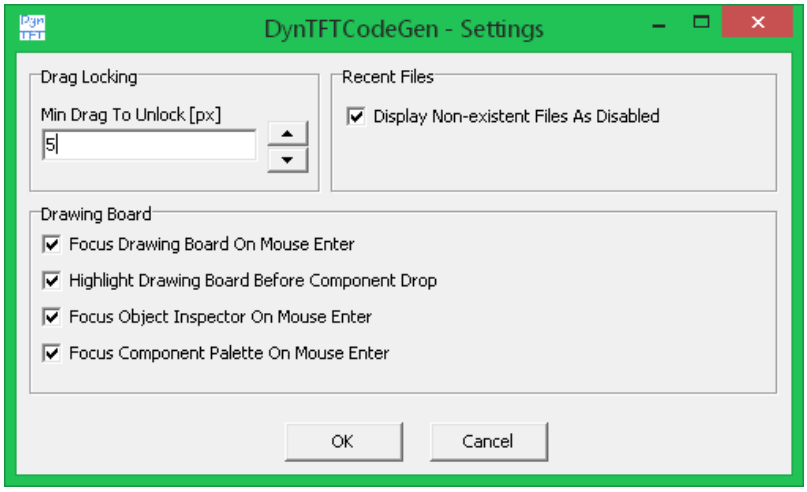
The screen name is not part of a namespace, it is simply a design convenience, so there is no restriction in having two or more screens with the same name.



There are also few screen related settings on project settings dialog, which will be discussed later, in another chapter.

7. Application level settings

Accessing general application settings can be done from the main menu, "Tools" -> "Application Settings...". A small dialog opens, as in the following screenshot:



The "Min Drag To Unlock [px]" editbox allows setting the minimum number of pixels the mouse has to move when dragging a component, to actually start the moving operation. The default value is 5 pixels and this feature can be switched off by setting it to 0. When set to 0, a component is dragged by mouse immediately as the mouse moves. This setting prevents accidental dragging of a component when clicked. Its maximum value is restricted to 10px. If that is still too small for a very sensitive mouse, the components can be locked.

The list of recent files, under the main menu, "File"->"Open recent project" item, contains all files loaded or saved by the application. Over time, some of them may be deleted, renamed or moved on disk, so they can be displayed as disabled, using the "Display Non-existent Files As Disabled" checkbox.

For the drawing board, there are currently four options, under the "Drawing Board" group box. There are three "Focus.." checkboxes, for the drawing board, object inspector and component palette. When checked, one of the three mentioned components is automatically focused when hovered by mouse. This is especially useful for the drawing board, because various operations like Copy/Cut-Paste, moving components, resizing components, selecting component etc, are active only when the drawing board is focused. When another component is focused, the drawing board

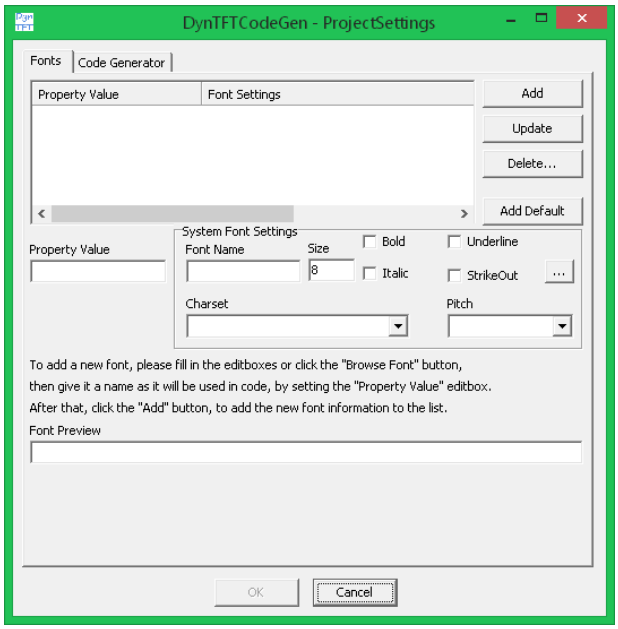
loses focus, so its keyboard shortcuts won't be available. When the "Focus Drawing Board On Mouse Enter" checkbox is unchecked, the drawing board will have to be focused manually by a mouse click. The other two "Focus.." options are mainly for causing the drawing board to lose focus.

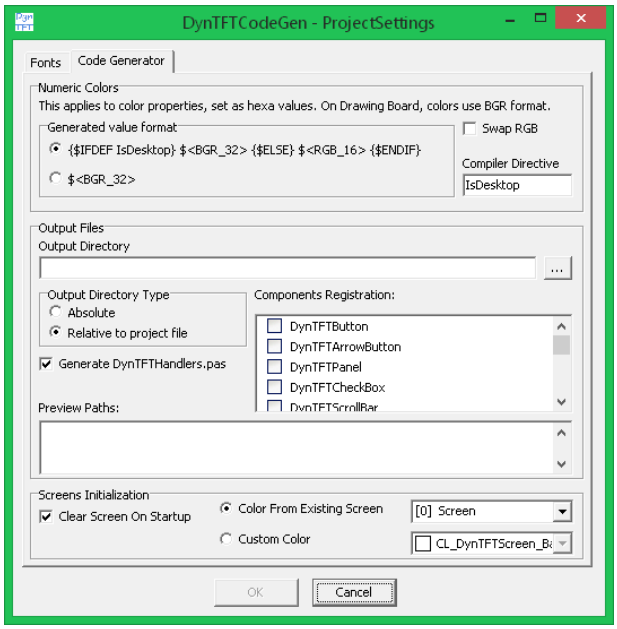
When dragging a component from the component palette to the drawing board, the drawing board can be highlighted with an extra border. This can be switched off by unchecking the "Highlight Drawing Board Before Component Drop" checkbox.

These general application settings are saved to the *DynTFTCodeGen.ini* file when closing the application.

8. Project level settings

Every project can be customized with a multitude of settings, from the "Project Settings" dialog, accessible from the main menu, "Tools" -> "Project Settings...". See the following screenshots:





The dialog consists of two pages, "Fonts" and "Code Generator". Other settings, like the screen settings, are not included in this dialog.

8.1 Font settings

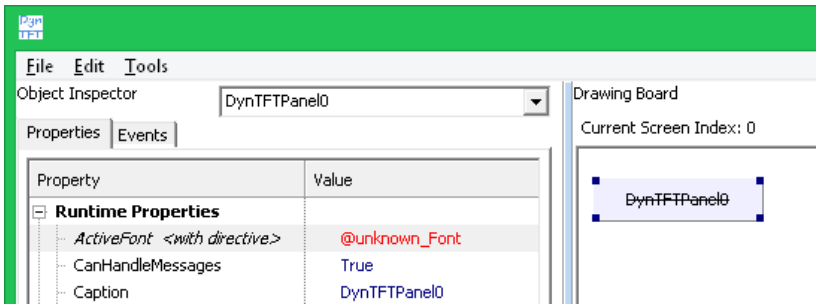
From the first page of the dialog, fonts can be added, edited and removed from a project. They have to exist in a project prior to being used as values for the "ActiveFont" property of various DynTFT components.

To add a new font, either browse system fonts, using the "..." button, under the "System Font Setting" groupbox, or manually type a font name in the "Font Name" editbox. Set its options under the same groupbox, then give it a name in the "Property Value" editbox. This name will appear as an option when setting the "ActiveFont" property of a component. It can also be preceded by the "@" character if fonts will be included in the DynTFT project as internal fonts. After filling in all these settings, press the "Add" button. The new font should be added to the list. As an example, the default font can be added from the "Add Default" button. This will add "@TFT_defaultFont" as Tahoma, 10, bold. It has to be mentioned that adding the default font to a project is not needed, because it automatically exists and is used by default. However, if added and customized, all

components which use it will display the new font settings. This is useful when using custom TFT libraries, which either hardcode the default font settings or allow the font to be customized.

Updating an existing font, requires the font to be selected in the list, its new changes to be set, from the "System Font Setting" groupbox, then the "Update" button to be pressed. Deleting a font can be done from the "Delete..." button if selected in the list.

When selecting a font which does not exist, as a value for the "ActiveFont" property, the application will display a striked out small font. See the following screenshot:



This can happen either after removing a font from the list, or typing in a non-existent font.

As mentioned before, switching a DynTFT project from internal to external fonts, using the "UseExternalFont" compiler directive, may require removing the "@" prefix from font property values. There is no automatic means of doing this, so font settings will have to be updated manually. The same for components.

8.2 Code generator settings

On the "Code Generator" tab, from the "Project Settings" dialog, various options are available. There are three group boxes, "Numeric Colors", "Output Files" and "Screens Initialization".

The "Color" and "Font_Color" properties of DynTFT component, can be assigned to color constants or their numeric counterpart, in hexa format. DynTFTCodeGen works with 32-bit colors (the most significant byte is not used), in BGR format, as provided by the operating system. Color constants are defined in the DynTFTConsts unit, for the desktop simulators and the TFT library for the microcontroller applications. In addition to that, theme specific colors are defined in their color themes as well. All these constants are declared in two ways, 32-bit (BGR) and 16-bit (RGB). DynTFTCodeGen can generate code for assigning "Color" and "Font_Color" properties with any of these options. The "Generated value format" group box allows selecting between a switch of 32-bit vs. 16-bit values for desktop vs. MCU code, and 32-bit only. When selecting the first option, "{$IFDEF IsDesktop} $<BGR_32> {$ELSE} $<RGB_16> {$ENDIF}", the generated code contains both version of the color, in 32-bit and 16-bit format. For desktop, it will use 32-bit and for the microcontroller, the 16-bit one, as specified by the "IsDesktop" compiler directive. This compiler directive can be changed from the "Compiler Directive" edit box, but for now, this is the name the DynTFT library supports. It has to be mentioned that the same compiler directive is used when generating code for the "ActiveFont" property, between desktop simulator and MCU project.

The second option of the "Generated value format" groupbox configures the code generator to generate only 32-bit values. This is desired when using custom libraries, which support 32-bit colors. The last setting in this group box is the "Swap RGB", which causes the code generator to generate all color values with red and blue channels being swapped. This may also be the case for custom TFT libraries.

The "Output Files" group box, allows setting the output directory for the four output files, *DynTFTGUI.pas*, *DynTFTGUIObjects.pas*, *DynTFTHandlers.pas* and *DynTFTFonts.pas*. In addition to the three .pas files used by DynTFT projects in the previous DynTFT versions, there is

one new file, called *DynTFTFonts.pas*, which is used for the DynTFT simulators only. The output directory can be relative to the project file, or it can have an absolute path. For relative path, the application can't properly handle network locations. According to the path settings, the "Preview Path" listbox displays the actual path of the output files. It will display actual path only when the DynTFTCodeGen project is saved.

By unchecking the "Generate DynTFTHandlers.pas" checkbox, the *DynTFTHandlers.pas* will not be saved/modified by DynTFTCodeGen.

The last setting in the "Output Files" group box, is the "Components Registration". It is used when generating the "RegisterAllComponentsEvents" procedure from the *DynTFTGUI.pas* file. Every registered component increases code size in the final microcontroller application, so commenting out unused registration function, helps decrease the size. DynTFTCodeGen automatically sets various components to "checked", in this list, if they are used in the project or they are dependencies of used components. Users can additionally check components if they know they will be created dynamically at run time, instead of being handled by DynTFTCodeGen. When a simulator displays an exception like `Exception while executing DynTFT_GUI_LoopIteration: PDynTFTMessageBox was not registered. Please call RegisterMessageBoxEvents before creating a PDynTFTMessageBox. It should be called once in RegisterAllComponentsEvents procedure from DynTFTGUI unit.`, then a component registration is missing, which can be added from the "Components Registration" list.

From the last group box, "Screens Initialization", users can choose to clear the screen with a rectangle, at application startup. This can be done by checking the "Clear Screen On Startup" checkbox. The "clear screen" color is selected from the remaining controls. When the "Color From Existing Screen" radio button is selected, the color used comes from one of the available screens. For the "Custom Color" option, users can use any of the available color constants, or a custom color.

9. Code generation

Many features of the code generator were mentioned in previous chapters, leaving here the most specific ones. The code generator is able to fully generate all four files, *DynTFTGUI.pas*, *DynTFTGUIObjects.pas*, *DynTFTHandlers.pas* and *DynTFTFonts.pas* and to edit the already existing *DynTFTHandlers.pas* file. The first three files are included in a DynTFT microcontroller project, via the *DynTFTGUI.mpas*, *DynTFTGUIObjects.mpas*, *DynTFTHandlers.mpas* files. The last one, *DynTFTFonts.pas* does not have a microcontroller counterpart, because it is needed at desktop only.

Editing the *DynTFTHandlers.pas* file means adding event handlers, both in the interface section as the headers, and in the implementation, their implementation code. To identify various sections of the file, and allow proper code inserting, the application uses "code generator symbols". These are strings, added to the headers of procedures/functions and also to their "begin" and "end" keywords. They come as comments at the end of a line, and look like "`//CodegenSym:header`", "`//CodegenSym:handler`", "`//CodegenSym:handler:begin`" and "`//CodegenSym:handler:end`". Please do not remove these strings, to allow proper application functioning!

As mentioned before, DynTFTCodeGen does not keep track of various DynTFT project settings, defined by compiler directives, so they will have to be manually managed. Parts of the generated files come from the "OutputParts" files from the "\OutputParts" directory, allowing future project customizations. Users can even install DynTFTCodeGen into separate directories with different "OutputParts" files, depending on application needs. For most of the cases, include files (*.inc) can be used to add custom units and raw code.

Custom TFT libraries can be used when the DynTFT project defines the "UserTFTCommands" compiler directve. As mentioned before, color themes have to be manually configured, DynTFTCodeGen allowing only to preview them.