~ MHz Beginners+ Tutorial Projects ~

Visual TFT Files: The User Code program templates

Complete with MikroBASIC Pro for PIC32 and dsP33EP MMB Example Files for a 9,999,999 Event Counter Custom Display Gadget (PIC18F MMB mPASCAL version coming soon)

MANUAL CONTENTS by ORDER: *Version 3.0.0 12/15/2013*

New for this Version: Longer page format to allow for expanding the information in the topics, Sectioning applied to subtopics, Made with Apache OpenOffice 4.0.1.
Graphics: Pro Tips Scrolls, Fontwork Gallery, Flowcharts, Callouts, Block Arrows, Symbol Shapes, Gallery Images.

INTRODUCTION:

Legal Stuff:

I think there is a law somewhere that says I have to say this: Not responsible for anything that goes wrong. No warranty is implied or applied. Use at Own Risk. If you suddenly feel ill or faint or vision goes blurry or experience chest pains or have difficulty breathing, Stop using this Tutorial and seek medical attention. All trademarks are the properties of their owners.

First Things: For those friends viewing this from around the world; I am ***American***- *So Please Forgive My* ***English***. I have No intentions of insulting anyone. So if you use any translator application(*s*) on this document, I did not say anything about your *Mother*, *Brother*, *Sister*, *Wife*, *Husband, Girlfriend, Boyfriend* or any *family members* including the ***Dog*** or ***Cat*** no matter what *it* says **I** said *ok*? ;^)

This is the manual for the **V-TFT** ***Event Counter Tutorial Example project***. This manual has additional information about the design and operation of the project and information about creating projects in **V-TFT** that apply in general so no matter which programming language or hardware you are working with, the information still applies, unless stated otherwise.

All code examples and the entire project are in the **mikroBASIC (*mBASIC*)**, language from **MikroElektronika**. This manuals instructions assume the reader (***you***), have already read the **V-TFT Help** file that comes with it. If you have not read the **Help** file, it advised that you do so ***first*** before reading this tutorial. It is *not* required to *before* using this manual, but this manual is intended as a ***supplement*** to the **Help** file, not a ***replacement***. There is information in the **Help** file you will also need to know in order to be successful in creating working projects in **V-TFT**. I will ***try*** very hard to keep the references ***generic*** and ***non-specific*** to any **HW** ***whenever*** possible. This ***can't*** be helped in the **projects** code listing section obviously. Since all of the example code was written in **mikroBASIC**, I have included the **2** files ***complete code listings*** that are the ***focus*** of this tutorials topics in this document so users of **mikroC** and **mikroPASCAL** have an easy way to also access their contents.
I did not want to ***exclude*** any **users** of **V-TFT** just because I or you do not have and use all of the ***compilers***. My wanting to make sure ***everybody*** could benefit from the example project is how this **PDF** manual got started. Once that happened, it seemed only natural to make use of its potential to include more than just commented text, and I just cannot *help* myself from ***pushing*** buttons and ***clicking*** format controls when they are on my screen.

This project is not a fully dressed out application as the result of keeping it sleek and simple. But it can be used as the starting point for anyone to expand it more. That was intentional planning also.
I guess it could be thought of being kind of like a science experimenter kit many of us have grown up with. The parts are here (*mostly*), you just have to finish putting it together the way you want.

This tutorial manual is also a *work-in-progress* effort. I want to give you as close to *100%* of the accumulated knowledge of using **V-TFT** as I can. But I *cannot* do it all at once, so there will be updates to this manual over time as I get the material put into it. I am also learning to use some features of ***Apache Office*** that I have not tried *before* and the editing ***does not*** always go as I would have liked. But I have discovered features that I can use to make this document present the *information* in better ways than just text (*and I'm sure some would really like that*). ***(Or you can look at it as lessons in American English?)***
So please bear with me as I work on getting this finished.

I hope you enjoy the results. R.M.T.

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About Visual TFT for new users:

Note to Experienced and Advanced level Users:

While I targeted this manual as a *beginners tutorial*, ***I feel*** I included material that *everyone*, no matter the skill level, can find ***useful***. *If not, you didn't waste any money right?* Most of that material is in the section **V-TFT TIPS & TRICKS** but you might find other bits of useful information in the rest of the material and I hope so. Check also the **The MAIN Loop and Multitasking in V-TFT Flowcharts** section and challenges at the end of this document.

Visual-TFT (***V-TFT*** *here on*), is a ***unique*** software development tool for creating **GUI** or non-**GUI** applications for all of the **M**ikro **M**edia **B**oards (***MMB***), and hardware development tools that use a **TFT** display device from **MikroElektronika**. This means it also supports all of the different **Compiler** languages too. This makes it a very versatile platform, allowing users to have the choices of what hardware and programming platforms they work with. That being said, it would be ***impossible*** for me to write a tutorial that covers every **HW** device and ***programming language***. So *details* are limited to being ***general*** and in **mBASIC**.

Knowledge of programming *Micro controllers* in one of the programming languages {**mBASIC** , **mPASCAL** or **mikroC**} is required to finish a **V-TFT** project and having a ***licensed unlocked*** **Compiler** (*in one of the languages*) to compile any project(*s*) you make. **V-TFT** projects are ***too big*** for **Demo** versions of the **compilers**.

The information in this document is intended to help you get a good idea of what ***is*** possible and ***not*** possible using **V-TFT**. It was clear to me that new users can have a *distorted* idea of what **V-TFT** ***does*** and how to make use of what it actually ***can do***, from my own experiences and seeing what questions are being asked in the forums. I felt I could contribute some help to the community of users by making this example project that explains in more detail how **V-TFTs** output code is organized.

One of the problems, ***I*** *feel* **V-TFT** *causes*, is that first time users initially are presented with program files it creates that are not, *on first look*, ***understandable***, because many new users have minimal experiences with multiple file projects and the **V-TFT** Help file *does not* contain the information they need to clear up the confusion. It is also my hopes that **MikroElektronika** will address this in the future.

V-TFT creates a ***Framework*** for you to fill out and complete to make a fully functional application. The ***Framework*** code **V-TFT** produces to manage your screen display and **TP** input associated to your **Objects** usage is structured as a **Task** (*Routine.* ***Check_TP()***) that needs to be executed (*called*) repeatedly in order to detect (*catch*) **TP** touch activity. This **Task** does ***not*** sit and *wait* for **TP** activity to happen and respond to it. It checks for activity when executed, and if none detected, exits the **Task** *Routine*. So users have available the groundwork for ***multitasking*** **Task** (*procedures*) management. This powerful framework design means you can make applications that are run entirely inside the Framework of the "Check_TP" routine for simple applications, or your project may require the management of other HW be done as a Task of their own.

This Tutorial and Example **V-TFT** Project → **mikroBASIC Pro** (*for PIC32 mmB*) **Compiler** Language Program files demonstrate a simple ***2 Task*** example to help you get familiar with the "***User Code***" areas and the ***Framework*** of the **V-TFT** output ***Code Template*** so **You** can *plan* how to get *your project* idea up and ***working***.

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About what V-TFT does not do:

It can ***not*** create fully programmed programmable applications from what you design in it. You will still have to edit at least ***one*** of the files it makes in a ***compiler*** and **add** additional programming *code* to complete the *templates of code* it does make for the *objects* you used on the projects screen(*s*).
The output for a project made in **V-TFT** must also be loaded in to a *Compiler* as a ***multiple file project*** so it can be compiled in to the *binary* file needed to program a *device* with. **V-TFT** does not output files that are ready to be programed into a *device*. The output of files it makes ***need*** to be put in to a **compiler** for the *language* it is set to use and *compiled before* the project can be programmed into a *device*.

Only a *very simple* project could be made that did not require you to do additional programming. *Sorry* but you still have to do some work. Good news is that it would not be as much as you would have to do if you did not use **V-TFT**.

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What V-TFT is NOT:

V-TFT is ***not*** a add on ***library*** to the compilers. **V-TFT** is ***not*** a tool that **makes** *libraries* for the **compilers** either. **V-TFT** is ***not*** a *code* **editor** or a *code* **compiler**. **V-TFT** is ***not*** a device **programmer**. **V-TFT** is ***not*** a device *library* **maker**.
V-TFT is ***not*** required to be ***running*** while editing a project in a **compiler** or even required to be *installed* on a **PC** for the **project files** it makes to be ***finished*** in a **compiler** and programmed into a *device*.

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What V-TFT is:

V-TFT ***is*** a ***stand-alone*** development tool to aid the user (***you***), in creating **TFT** screen content that can be almost any mixture of **T**ouch **P**anel (***TP***), input controls and output displays of control settings, text, graphics and anything the target device is capable of needing displayed on a **TFT** screen. **V-TFT** gives the user a *graphical development environment* in which to work and a selection of screen **Components** (*also referred to as* ***Objects***), you may use individually or in combination to make the ***I/O*** graphics you need for your desired applications. It (***V-TFT***), provides a ***W**hat **Y**ou **S**ee **I**s **W**hat **Y**ou **G**et* (***WYSIWYG***), designing environment for the target hardware (***HW***) you want that it supports. **V-TFT** ***is*** a project ***application code template generator***. **V-TFT** ***is*** a projects screens *code manager* so users can have **multiple** screens for different organizations of **I/O** designs as they need, ***within*** the ***capabilities*** of the target **HW** (*memory available, **MCU** functions embedded .....*).

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What V-TFT creates:

V-TFT will make programming language code files based on your selections of project options to use. You can see more information about this in the **V-TFT** Help File. The ***Help File*** will show you information about every ***menu item*** and ***control*** *available*. What files are created and what they contain depends on the *users* **project** ***selections*** made at ***anytime*** during its designing. If you need to, see the ***Help File*** for more information on this. **V-TFT** takes the *graphical elements* (***Objects***), you place on a screen and *creates* the ***program template*** and ***program code*** that sends the data to a display controller to ***reproduce*** the **Objects** as you designed them on a **TFT TP** screen. This is done for everything created in **V-TFT** or ***needed*** as supporting ***Data*** or ***Executable*** code for a **project** so it will be included when the project is ***compiled*** before programming the target HW device.
See the ***Help File*** about project ***Objects File*** and ***Resources File***.
They contain the needed supporting *Data* Code. **Objects** and **screens** are *configured* as different **object** *structures*. Some are **Dynamic** (***RAM*** *Variables*) or **Static** (***Code*** *constants*) and each has its supporting Pointers and data type structures. The ***program template*** it creates provides *areas* for your applications **User code,** for **Event Handler** routines, (*empty of executable code*), for screen *objects* that are ***active*** to ***touch.*** Routines for the devices **HW** *initializations* and what is called the **V-TFT** ***Stack*** and ***Core*** *code* in the *projects* **driver** module file. These files will be in a format that corresponds to the ***Compiler language*** selected in the ***projects options***.

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The Intentions for this manual and example project:

Since I intended for this to be a fun ***beginners guide and tutorial*** manual, the more advanced features and descriptions will **not** be covered in this document. A future *advanced topics* document is planned, but I am waiting to see what *MikroElektronika* will have in the official **Visual-TFT** **Users Manual** that is to be released, *date unknown*.

That is also why I decided to make this ***beginners*** tutorial, as a band-aid for everyone who needs it until something official is released. *If* you found the **V-TFT** Help File *not* helpful for ***every question*** that arises when you use **V-TFT,** this document might address a few or more of those new user questions. ***I tried*** to remember of as many as I could that are ***important*** enough to get **you** *started* on making **V-TFT** projects that ***won't*** have *conflicts* with how the ***program template*** is *intended* to be used.

This tutorial is a guide to ***help you*** get started and make you aware of some *dangers* that can *cause* your **project** to *not function* as **intended**. Where I stress the *importance* of *doing* something or *not doing* something in the projects code files, is ***not absolute***, but ***my suggestion*** that unless or until you are more advanced in skills enough to know how to *avoid* the ***dangers*** associated with going against the suggestions, *you should not*, but keep in mind there are usually *exceptions* to the **rules** implied and you may one day need to disregard them to have success with what you want to do in a **V-TFT** project.
It is easy to say "*Keep an Open Mind*", but ***hard*** to do daily.

I also wanted to pass on some **Tips and Tricks** I have discovered myself or learned at some point in my life or found on the forums. I will try to acknowledge who's **Tip**, **Trick** it is if not my own or of public domain source. I do not want to anger anyone by any usage of any content in this document. If you think you should have credit or reason for anything to be removed, contact me by email and I will discuss the matter with you.
If you want to *submit* any thing that would be helpful also or a good alternative to any procedures, ***please do*** and I'll do updates to the document. Post on forum thread or comments at the **Examples** **LibStock** blog.

At the time of this writing, **Visual-TFT**'s Version is **3.7.0**. So the information in this documentation is subject to being *out of date* or *inaccurate* at any time. I plan on updating it from time to time or if something important needs to be added or removed or changed. There are some topics about **V-TFT** that I want to expand the coverage on so there will be updates as the new material is completed. So check periodically if there is a new version of this document available.

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Tips and Tricks

Visual TFT TIPS & TRICKS for success: *(For All Skill Levels)*

First, 3 rules you should know before, and while programming anything:

I call these **RULES** *the 3* **Laws*** *of programming.* ***(like the 3 laws of Robotics)**

RULE #1- **NO** program **YOU** write will **EVER** run and **DO** what ***you wanted*** it to **DO**, it will **ALWAYS** run and do **EXACTLY** what ***YOU told*** it to **DO**!

RULE #2- If data is **corrupted**, it will still run and do **EXACTLY** what it was told to **DO**, if it can, but **NOT** what **YOU** told it to **DO**.

RULE #3-* Just because a program compiled **without** errors, it does not mean there are **no errors** or **guarantee** it will execute as wanted - see **RULE #1**.

**** Aleksandar and I agreed during a discussion there needed to be a RULE #3 to complete the LOGIC circle.***

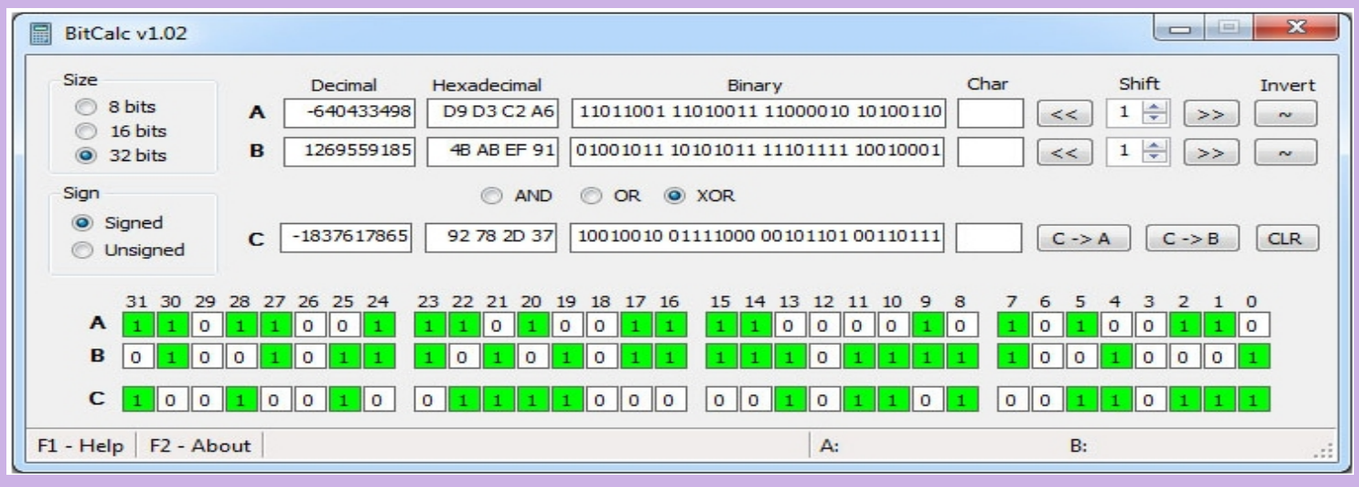
So learning how programmable digital systems actually operate to follow a programs instructions will be one of the best tools you will use when writing your own programs. I did not make the rules, they are a natural result and inherent to all programmable digital devices.

V-TFT USER MANUAL?

As of this writing, there is no **V-TFT** users manual published *yet*. There is its included *help* file [**F1**], and the **forum** and **MikroE's** support desk for serious problems to be handled promptly by staff members. The forum is a great and valuable resource for solving most issues you might have while using **V-TFT** or their other **HW** and **SW**. Questions will be answered if anybody knows the answer. So use it when needed and maybe you will avoid many frustrations others have already *had* and *solved*.

Bit Calculator:

Get the "**BitCalc**" tool that Aleksandar Vukelic made and can be downloaded at http://www.libstock.com/projects/view/666/bitcalc if you do not already have it.



It will aid you in learning about **Bit Masking** and using **Bit** *operators* in programming **+ much more!**

I consider it an ***essential*** tool for programming and troubleshooting your code and analyzing others code to see how logical operations programmed get the right results (*or wrong*). It is a stand-alone application that can be added to your compilers External Tool's configuration so it is always at hand.

When designing in V-TFT, it is usually better to make the least complicated interface at first, then test it, and if that works, then consider what to change to add more elaborate features,

Try to do the project in discreet small chunks of functions, checking the functionality of each as you go.

Use, Use, Use your compilers comment feature to give yourself guidelines and reasons why that code is there, and what it is supposed to do – **remember RULE #1?**

You do not have to comment everything just like I did for this example project, but try to help your *future* self with what you are doing *now* in your code.

Start Simple to test devices configurations FIRST:

Before jumping in and trying to make that multi-screen **GUI** you have been thinking about for a long time now, you should do a very simple 1 screen test project from scratch to make sure you have selected the correct device **HW** *configuration* settings that work and you can get the *device* to show the **TP** calibration (*if equipped*) screen and the first screen of the **V-TFT** test project with at least 1 (*active*) **Button** on it, so you can test that the **TP** works at desired ***touch pressures*** and can be ***accurately calibrated*** when programmed and ***powered up*** to *run* the **program**.

Simple test setup = simpler troubleshooting to do, if needed.

V-TFT examples to consider also:
There are a great many *program examples* available for all of the hardware and software **MikroElektronika** makes. Some *examples* you may not consider to check is because you do not have that hardware, but you might pass up ***the exact*** or ***helpful*** *example* if you do not consider them. *For example;* you must have one of the **TFT** products if you are even reading this, but have you gotten and looked over all of the *examples* for any of their products that include or can have connected a **TFT** display?

If you are using one of their **MMB's** for **PIC**, but do not have the ***mikromediaWorkStation*** development system, you should still get all *examples*, *libraries* and the *documentation* for it. Now you would have *schematics* for wiring the **MMB** to a lot of other external **HW** *AND* ***examples*** to run or examine for *how* to interface to such stuff. There is a good chance that there is something just like you want to do or very close, to use as an *example* that can help you with *your* ***project***. This applies to any ***common core*** **HW** and **SW** product lines you use of ***theirs***.

Do not short yourself of what is available to aid you.

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Rename the Objects in your Project:
Take notice of how I named the **V-TFT** *button objects* in this *example*. By putting a *Underscore* **"_"** at the end of the name, the "***OnClick()***" **V-TFT** adds won't make the name so *hard* to read in the code. Change the names of your **Objects** ***before*** you *assign* any events to them. **V-TFT** *does not* change the name of an *Action Event routine name* assigned to an **Object** when the **Objects** name has *been changed*. You only need to do this to **Objects** that will have touch events assigned, it won't be needed for other **Objects** as they don't get *suffixes* added to their names by **V-TFT** unless you assign an ***Event*** to it.

Even though **V-TFT** *automatically* assigns names to the **Objects** as they are added to a project, leaving the names as is will cause you difficulty for keeping track of many **Objects** and their properties on different screens in *large projects*. I have developed this ***naming convention*** that helps me out and *maybe it will help you* ***too***, or give you ideas on doing ***your own version***.

If a *project* has more than one (**1**) ***screen***, I name every **Object** with the ***screen name*** it *belongs* to as the ***prefix*** to the name – **Screen1Box1** and a **Screen2Button1_ Object** will have **Screen2Button1_OnClick()** for its routine name, when assigned.

If an Object is used as a *display* of data or *indicator,* Its name should *reflect* its *purpose* - Screen1OnLight instead of Circle1 ... You will have to remember the Objects *type* so you use the correct **V-TFT** *drawing routine* for each **Object**, but you will find writing your code *easier to do* and ***reading*** it will make more sense with ***descriptive*** names. You do not ***have to*** rename every **Object** used in a *project*, but any that you have to ***refer to*** in your ***User Code*** **should be** renamed.

Variables and constants naming:
You might find this ***useful*** or ***not***. Normally **Constant** *identifiers* (*names*) are done all in **UPPERCASE** so just looking at the name tells you it is a **Constant**. If you look at the ***User Code*** in this tutorials *example project*, you will see that I also have all of the **Variables** names in **UPPERCASE** *too*. I find this helps me when *looking* over the code ***I write***. There is no *confusing* them with ***routine names*** or ***language Keywords*** by doing this I find. I leave all programming ***Keywords*** in **lowercase** and ***routine names*** are just **capitalized** (*each word in the identifier, like this:* **Reset_Counter()**). The point is to have a ***system***, ***any system***, and be *consistent* with its **usage**. Making the code ***legible*** and ***easy*** to discern the **elements** is the goal.

If you save the job of assigning events *(creating event subroutines in event module)*, to the objects for last, and you have more than one screen in your project, you can assign events one screen at a time and the created routines will be grouped by screen together in the events file. If that confused you, do not worry, you will understand it when you make your first project with more than one screen.

You **Can** *re-arrange* the **Event-Action** *Routines* once they have been made in the "*Event Handler*" section of a **Projects** ***events_code*** File. Edit either in **V-TFT**, or in a **Compiler**. If in **V-TFT**, any new ones made are placed *after* the last ***end Routine*** statement.

You should save the job of assigning Events to Objects for the last if possible.

If you can, do all of the graphical work of your screen(*s*) layout and components properties ***before*** you have time *invested* in programming code for them. There is always a good chance that you will change the design at least once before you get the design how you like or need it to be, in order to function. Test compiling and loading a screen before doing the code work can ***save*** you from doing work that won't be used in the end project.
V-TFT object editing is a ***lot harder*** if there is also program code *associated* to the *objects*. **Example:** If you copy an object that you have assigned a **TP** activity event to do when triggered, the copy will ***also*** have the **same event action assigned**. You may or may not have wanted that to be. If you did, then no problems, but if you want a different event routine to be assigned to the copied new object, you will probably end up **deleting** the *original objects* event routine trying to clear the assignment from the copied object.

Only copy an object that ***already has*** an *event* action *routine* assigned to it, ***if*** *you* ***want*** the ***copy*** to ***use same*** *routine* or there **is *already*** a event *routine* ***made*** you want it to use instead. Otherwise – using a **new** component instead is *easier* and *saves* you ***trouble***.

You cannot rely on the **V-TFT** ***"Undo button"s*** *functionality* to save you from project damage due to a software bug. Keep a backup in a separate folder that you can update manually after a editing session is finished.
I have rarely gotten the results I expected from using it.
It may function correctly for normal editing mistakes, but if you are trying to reverse the results of a **V-TFT** software ***bug***, there is a good chance it will cause **more** damage to your project, up to and including ***TOTAL LOSS*** of project being usable or loadable into **V-TFT** again.

It is *easier* to **copy** an object that has a lot of ***properties*** set like you want another one to have, than configure a new one added from the **component palette**.

Bug in V-TFT ver. 3.7.0 - *Grouped Objects*. Having ***any*** group(*s*) of *Objects* in your **V-TFT** project when project is *saved* or *sent* to **compiler** directly, when *compiled and run* on device after loading, *will* cause your application to ***freeze*** up trying to draw the *screen* that has any ***Objects Grouped together***. Make sure you ***UN-group*** all **Objects** in your project **IN V-TFT *before*** trying to compile and run it on a device.

The keyboard "**SHIFT**" key when held down, allows you to **left-click** on objects to *add* or *subtract* them *to/from* multiple selected objects for grouping or moving or deleting.

The keyboard "***Ins***" or "***Insert***" key toggles between **Insert** and **Overwrite** *modes* in text (*code*) editors.

Not all **Components** have a "***Static***" property because they have *properties* whose values must change in order to function as designed. Since they are "***Dynamic***", you can ***take advantage*** of changing any of their *properties* to achieve ***visual effects*** to help indicate a **state** or **condition** is in ***affect*** in your application instead of adding more **Objects** to your project to do the same.

If you need to change any **Objects** properties from your code *during* **run-time**, it **MUST** have its "***Static***" property set to **False** in V-TFT ***before*** you send the project to a compiler.
If you will ***not*** be changing an **Objects** properties from your code *during* **run-time**, you ***should*** set its "***Static***" property to **True** so **RAM** memory is ***not*** *wasted* holding all of its properties values.

For your own **V-TFT** projects, it is best that you save them in a **different** folder than the **'Projects'** folder in the **Visual-TFT** install folder.
If you have to uninstall **V-TFT** before an **update** can be installed, your projects may get **deleted *if in that folder***.
Putting your projects in a ***folder*** in the '**Projects**' folder should prevent that from happening also.

You can use **Layers** to group same object types together by layer or have all objects used to make a custom display or control on its own layer so easier to move or hide on the screen

If you use any **Objects** to make a background for the screen, putting them all on a Layer by themselves makes it easier to get the background back underneath all other objects should you need to.
Right-Click the background **Layer** in the "*Layer Window*", select **all Layers Objects**,
Right-Click on a selected **Object**, select "*Send to Back*".

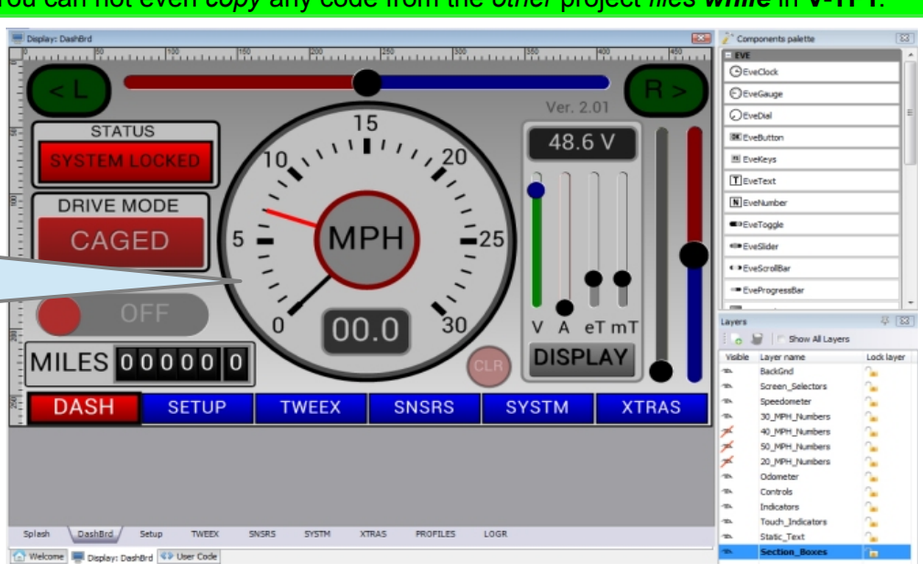
When using many layers to separate and organize the objects on multiple screens, any time you change the screen being displayed in the **V-TFT** screen edit window, the selected **Layer** for editing activity will be the last **Layer** (*Bottom of the Layer window list*), not the one you were using ***last*** on that screen.
The **Layer** selected for a screen is not persistent.

An indication that there is a "Object Party" happening you were not invited to:
Check what **LAYER** is selected after adding a ***new component*** from the **Palette** or *Pasting* a *Cut/Copied* object to the screen, if you are using multiple **LAYERS**.
I say this because I still find some of my Screen **Objects** having a party with **Objects** that live on a *different* **Layer** than the ones I "thought" I put it with. ***(See the section about moving Objects around on Layers to fix)***

If an **Object** has its **Static** *Property* set to "**TRUE**", during ***run-time*** the ***Only thing*** you can *do* with it is "**Redraw**" it. You *cannot* **move** it. You *cannot* **change** its colors. You *cannot* **change** if *visible* or *not*. You can only *redraw* it or any other **Objects** layered *over it*. ***No*** *properties* of a **Static Object** can be ***changed*** *during* run-time.

It is much easier to do the coding in a ***Compiler*** than in **V-TFT**. The only file you have full Read and Write access to is the "*User Code*" '***events_code***' file. You can not even *copy* any code from the *other* project *files* ***while*** in **V-TFT**.

Personal Project with EVE FT800 Breakout board. Multiple screen GUI Controller for Electric Bicycle ESC. Still a work-in-progress Project.
How many objects do you think are used for this Speedometer gauge? **Answer** is at the end of this manual.



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Components & Objects Tutorial:

PRO TIP:
The Number of different Objects used in a Project has a Major impact on the Code File sizes. Use fewer Types to save RAM & ROM MEMORY.

First lets make sure we are on the same page about **Components** and **Objects**. You will see both terms used in this document and in **Visual-TFTs** official documents (*Help File*), as referring to the same thing, and this is correct, *mostly*.
In the **V-TFT** program, they are listed in the ***Components Palette*** and divided into two groups – **BASIC** and **COMMON**.
I have come to think of it this way, and so I must let you know this so there is no confusion between us about term usage.

Component(s) – Term to apply to the different types of **Objects** ***available*** for you to use in your **projects**.
Components are usually ***made*** from *multiple* **Objects**.

Object(s) – Generic term a **Component** *type* is called once it has been placed into the **project** on *any screen*.
An **Object** is the simplest **V-TFT** *element* that you can use in a *project*.

IMPORTANT FACTS ABOUT COMPONENTS "STATIC" PROPERTY:

If the objects property is set to "**Static = True**" in **V-TFT**, *you can not change any of its properties during run-time*.
The property "**Static**" must be set to "**False**" for **ANY** objects you want to have their properties changed by code during run-time.
The Static property determines if the component will be coded in the output files as a structure of variables or of constants.
Static = **True**: *Object* is coded as ***Constants*** *structure*. ***NOT CHANGEABLE DURING RUN-TIME!***
Static = **False**: *Object* is coded as ***Variables*** *structure*. ***IS CHANGEABLE DURING RUN-TIME!***
This setting of the '**Static**' property ***has*** to be done to the **object***(s)* when you edit them *in* V-TFT so they are *structured* in the output code as either dynamic (**variables in RAM**) or static (**constants in program memory-ROM**).
You can not change them afterwords in a compiler as the whole structure for the object must be coded by **V-TFT** based on the setting of the **Object**(*s*) "*Static*" property. All code that handles the **Objects** *structures* (*pointers*) ***is set*** at *build time* in **V-TFT** also, so the setting of this must be done in **V-TFT** ***before*** compiling is done. Once an **Objects** *Static* property is set to **TRUE**, the ***Only*** operations that can be done with it is to ***redraw*** it and assign any ***Action Event*** **TP** *trap* to it. **Events** ***can be*** **assigned** to **Objects** with the *Static* property set to *either* **TRUE** *or* **FALSE**.

NEW TOPIC

How to Display Changing Alphanumerical Data with Components:

(I apologize that this lesson was not in the original tutorial manual, as it is a very important one for new V-TFT users)

The **V-TFT** *help file* ***implies*** that users only have the **LABEL** *component* to use for displaying ***changing*** *alphanumerical* **characters**. This is ***incorrect***. **ANY** *component* that has a "**Caption**" *property* is capable of displaying *changing data*, as long as its "**Static**" *property* is ***set*** to '**FALSE**' *(see above about the Static property)*. In ***my*** *experience*, using a **Label** for doing this is the ***hardest way*** to do so. Here is a short lesson on using the **Label** *component* to show ***changing data*** and the **alternatives**.

Using the Label Component to show changing alphanumerical Data on a Screen:

The **Label** *object* requires that you ***first*** *erase* the old data on the **screen** by changing the *font color* to that of the *background color* and ***redrawing*** the *exact same data* in the *background color (and at the exact same location)*, ***then*** putting the new data in to the **Labels** *Caption property* and change the font color ***again*** to a *different* **color** than the *background* **color** and then ***redraw*** the **Label** to ***show*** the *new data*. **Important** – There is another component property that ***must be*** **set** ***correctly*** when using ***ANY*** **object** to display *changing alphanumerical data*; The '**Max Length**' *property***!** This *properties* **value** ***must be*** **set** to the *maximum number* of **characters** that **you** will be placing into the **Caption** *property* of the **object**. The *default* **value** of **zero** (***0***) is to be only used ***if*** the *contents* of the **Caption** *property* will **NOT** be *changing* during ***run-time***. A **zero** *value* means that **V-TFT** will *automatically* **set** the *correct value* (*in the output code*) ***based*** on the *number* of **characters** the **Caption** *property* ***contains*** at project ***build*** *or* ***save*** and *usually* reserved for **Labels** that are ***Static*** in nature.

There **is** *another way* to ***erase*** the **old data** *without* the steps stated above; you can have the **Label** *layered* over a **Box** *object* and ***redraw*** **it** to ***erase*** the **old data** ***before*** drawing the **Label** ***after*** its **Caption** *property* is loaded with the **new data**.

As you can see, using the **Label** *component* to display *changing information* on the **screen** is *not* **straight-forward** and **easy**. And there is **no** ***justification*** that can be applied to the **contents** (*left , right , center*). **Labels** are ***fixed*** with **left justification**. **Labels** ***do*** have ***uses*** though. They are ***great*** for writing *alphanumerical characters* that are ***Static*** and need *never* **change**.

The Alternatives:

The alternatives are to use one of the other *components* that ***also have*** a **Caption** *property* like the **Buttons**. ***The advantages?***

Buttons *automatically* ***erase*** the old displayed data as they write the new data. (*less user code instructions needed*)
Buttons do not require you to change the **font colors**, but *you can* ***if*** *you want* to. (*again less user code instructions needed*)
Buttons have a **justification** *property* you can set as you want or change during run-time. (*again, less user code to implement*)
Buttons have a size *adjustable* **boarder** of *selectable* **color** and **width** you can *use* to ***emphasize*** the **captions** *content*. (*the equivalent of a* ***Label*** *drawn inside of a* ***Box*** *object, but a* ***lot less*** *user code to implement*)

The ***downside*** to using a **Button** as a **Label**:
There will *always** be an **area** *around* the **Caption** *contents* that gets drawn ***also***. This can be a problem for you based on how you have your ***layout*** designed, but changing the ***layout*** design **can** *overcome* this *most of the time*.
The **Button** must be **dynamic** (***Static*** = ***FALSE***) so having many **buttons** doing **labels** *function* ***eats up*** **RAM** *memory* ***fast***.
(*you* ***can*** *use* ***Static Buttons*** *for displaying* ***non changing*** *data still*)

You can set the *properties* of a **Button** so that it does not *appear* to be a **Button** ***also***. Setting the **Pen Width** *Property* to ***zero*** (***0***) will make it so there is **no boarder** and setting the **gradient** *property* to ***False*** and the **solid color** to ***match*** the ***background*** achieves this. ***But** if you set the **Transparent** *property* to ***True*** (*so background shows thru*), you *will have* the ***same*** **problems** with **erasing** *old data* as you have with using the **Label** *component*.

All **Caption** *properties* are expecting the information assigned to it to be in the **String** *data type* format with a **Null** *character* (***0***) *terminating* the **String**. There is no automatic conversions done to the data. You must have the data already in the proper type format (*String*) ***before*** trying to assign it to the **Caption** *property*. This is not a problem if only using **alphabetical** *characters*.
They are already of the **String** *data type*. But when you need to display **numerical** *data* with a **components** *caption*, you have to do the ***conversion*** to **String** *data type* **first** (*exception is the **EVE** Numbers component*).

The **Conversions Library** in your ***compiler*** has the *functions* needed to do this for every *numerical data type* supported by the **compiler**. Be aware though, the **result** from the conversion will be ***Right justified*** in the **target** *String* with *leading* **spaces** padding the *string* if the **number** of *characters* in conversion is ***less*** than the **declared** target string *variables* ***length***.

The "**Max Length**" *property* of the *components* **Caption** *property* is **its** *declared* **character** *length*.
Another **Library** has a *function* that can ***strip*** the **spaces** from the **front** (*left*) of a ***number-to-string conversion*** that is *less* in *length* than the **target strings** declared ***length*** if you need to have the spaces removed so your display looks like **you** ***wanted***.
The **Library** is the **String Library**, and the ***function*** is: **ltrim**(*string_variable*) *(left trim)*.

If you want *more* information and **Code examples** about this **Topic**, I made *another* ***Tutorial*** about it and it can be ***gotten*** at **Libstock** site also. That **V-TFT** example project *does not* have a **PDF** manual like this one with it though. **All** explanations are done as *comments* in the **mBASIC Pro** for **PIC32** Source Code Files – ***Main*** and ***Events_Code*** project files. This is why I have not included code examples in this tutorial, *I had already made them*.
Click **HERE** to open the Examples page at Libstock.com.

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Visual TFT Making your own Components:

I feel some talk about this is required. There has been requests for some additional components to be added to **V-TFT** and the ability to create custom components that become part of the components palette. While having some new components added to **V-TFT** would be nice, I think users are *not* taking *full advantage* of what can be done with what it has now. This is the main reason I made the example project that would be the reference for this tutorial. The **Event Counter display-Gadget** is an example of how to make a *custom component* using the available *objects* in **V-TFT**. By demonstrating how the **Display-Gadget** was made, you will also get a *lesson* about **Layers** and ***layering*** *Objects*. When you think about it, it is the purpose of **V-TFT** to give you the tools to make as intricate an interface as you want. If you use this concept, you can start building up a "***library***" of *reusable gadgets* you make or be able to use any that others put up to share *freely*. The **Display-Gadget** is the first one *available*, from *hopefully,* a growing list of them soon.

Here is the concept:
A custom *gadget*, like any built-in **V-TFT** *components*, requires ***two parts*** in order to work, **1st** are the graphical elements to make it a visual construct (*of objects*) and **2nd** is the code to be executed that provides the ***functionality*** of the *gadget*. This seems simple enough right? So,,, lets build one (*a fictional one for now*). Here are the steps to take –

1 – Make the custom component from the Objects available on a screen by itself.
2 – Make the routine(s) and declarations needed to support its functionality,
in "Event Handlers" and/or "User Code" and/or " User code declarations".
3 – Export the screen so it can be imported in to other projects.
4 – Load the "V-TFT Project" for the Gadget in to your compiler.
5 – Add a blank Module file to the project and place all routines in the new module file below "implements", and any declarations for variables and constants above "implements".
6 – Make entries of "Forwards" for the routine(s) that need to be seen external to this module above the variables and constants declarations. The modules name should indicate what "Gadget" it provides support for.

The objects used to make your "Gadget" that need to be manipulated by code should have unique names that can help indicate what functionality they are there for, so calling on them from the main project body will be easier to understand.

There will be more effort to get a better way to implement something like this functionality integrated into **V-TFT**.
For now will have to wait and see if the software development department at MikroElektronika will use some ideas submitted on having the feature added and to what extent they go with the concept. The biggest problem now with doing this is the way **V-TFT** will rename the *Objects* on the imported screen when bringing a **Gadget** into a project. If you try this, you will see what I mean and the problems it causes. I am pushing to have this fixed for a future release of **V-TFT**.

Did you know? **That Components are just a lot of TFT Library drawing functions that V-TFT generated code uses to make the Objects. They are pure data constructs that V-TFT driver code makes into components from predetermined code Templates for each Component.**

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Layers and Layering Objects:

A few words about **Layers** in **V-TFT** needs to be said before we continue on.
Layers are ***only*** a *organization tool* for users to use to help with the tasks of *editing* **Objects** and doing your design.
They ***do not*** have any effect on the display order or visibility of objects in the ***final output***.
Layers in **V-TFT** have ***no code structure*** or ***existence*** in the output code. They are to use only in aiding you while editing in **V-TFT**. A lot of users have voiced opinions that it would be nice if they were *a part of the output framework* and could be *controlled by user code* to have a form of *control over the objects on a **Layer** as a **whole***. Maybe it would be nice, but for now it is only a wish request and layers *cease to have any function outside of* **V-TFT**.
This *does not mean they are useless* or cannot *provide you with assistance* in making ***your design***.

Here are some examples of **Layers** and their purpose for possible usage practices for organizing a **V-TFT** project:
(*You can rename a **Layer** by **double clicking** on its name in the **Layers Window***)

[***Example Layers***]	[**---------- *Description of usage* ----------**]
[**Background**]	All objects that make up a screens inactive background graphics
[**Section Boxes**]	For placing Box objects that define the borders of areas by function.
[**Static Labels**]	For placing all label objects that will not change their properties.
[**Dynamic Labels**]	For placing all label objects that will have their properties or caption change.
[**Controls**]	For placing **TP** input objects
[**Indicators**]	For placing any objects that function as a condition indicator or Change appearance.
[**Control *name***]	For placing all of the objects that are used to make a ***custom* TP input**.
[**Display *name***]	For placing all of the objects that are used to make a ***custom* output**.
[**For Hiding**]	For any object(s) that your code controls the visibility but you need to not be seen while you continue editing in **V-TFT**.

There are more *uses* the **Layers** can be used for, and you will find the ones that are most helpful to you as you go.
Each **Project** may be different in how you use them if at all, based on the complexity of the design you are working on.

See the **BONUS CONTENT** *Section* in this manual for ***access*** to **real *hands-on* V-TFT Screens** you can examine *(and use the Objects from it if you want)* examples of the **Layers** *Usages* described above.

Authors note on additional examples for using Labels:

If you want more and better examples of displaying changing data on a screen with V-TFT, you can check out my other tutorial example V-TFT project for using "Buttons as Labels method" that is also available @ Libstock site. It shows how to use Labels in different ways and how to erase old data before showing the new data and how to do the same with the Button Components. You can compare each way to help you find the best way to get your project working like you want.
Robert.

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Object Layering in V-TFT:

While the ***Layers*** in **V-TFT** do not have *any effect* on the output code, ***how you layer Objects in*** **V-TFT** has great impact on the output and how the **TFT** display will be drawn. The drawing **priority** for the *objects* on a screen is first determined by the order they are placed on the screen. **Objects** placed ***first*** are drawn ***first*** and **Objects** placed ***last*** get drawn ***last*** by the ***drawscreen()*** routine in the *driver* file. The drawing **priority** can be changed for any **object** by *right-Clicking* it and picking one of the two options to move it to ***front*** or ***back***. Many **objects** can be ***stacked*** *(Layered)* over one another to create a visual display you want. Depending on the display controller you are using and the device **MCU** and *architecture*, having many **objects** *layered* on the screen may or may not look good in *actual practice* for any given **device**. It will depend on how you have them ***stacked*** and which one(*s*) need to be redrawn to perform its desired function. My best advice is for you to play around with some **objects** stacked (*layered*) over each other and see what happens when they are redrawn in different orders. For most display controllers, any area on a screen shows the ***last thing drawn*** there and what used to be there can be lost (*not visible*), *until* told to **redraw** it ***again***. For many applications, this is not a problem. For some, it will be due to how the designer wants to manipulate the display. If you *change* an **Objects** *property* that ***affects*** it visually, it ***won't*** actually **happen** ***until*** you ***redraw*** the **Object** using the **proper** object ***drawing routine*** (*see the section about Driver file drawing routine list also*).

One way to see how things will look when different objects are displayed or not, is to put the objects you want to test how they appear when stacked (layered) over each other on separate Layers and use the visibility control to make different objects visible or not to see the results. This can help you set up the proper front to back ordering so the application will give the results you wanted.

! The *number* of **Layers** added to a Screen has ***no effect*** on the projects build for run **file size**. The *number* of ***different*** **components** and *number* of ***different*** **Fonts** used are the ***biggest factors*** of a **V-TFT** projects *final* file size.

See the V-TFT Help file for more information on Layers and the controls available if you need more than this to work with.

TIPS for usage: If you are making a custom input or output gadget that uses multiple objects stacked over one another and will be copying it to make others, **DO NOT** have the objects on different layers. Place all of the objects on a single layer.
It is easier to start and build a gadget on one layer than to move the objects to a layer after starting to build it.

If you ***redraw*** an **object** that has other **objects** over it, they *will not* be ***visible*** any more and will require being ***redrawn*** also, *if your design needs them to be visible too.* The ***general rule is*** that you will need to redraw all objects "***forward***" (*to front*), of any object that you have your code redraw, if they are affected visibly by the ***rear-most*** object you had the program redraw. The **V-TFT** core code *does not* keep track of what has been redrawn by ***user code*** so the users must do this themselves.

For most display controllers, the **TFT** display is like a school chalk board, in that whatever is drawn last erases what was there before. But unlike a chalk board, you can redraw an object that lies underneath other **objects** drawn over it and have it now made visible, until other **objects** get drawn over it. This is the *basis for layering objects* on a **screen**. The **Layers tool** in **V-TFT** has ***nothing*** to do with *this architecture* of what is drawn on the display, ***unless*** *you* organize the **objects** to match the *layering* in the **Layers** you have made in **V-TFT**. You have the ***freedom*** to *organize* the **objects** and **Layers** this way or not. Just remember that the **Layers** ***cease to exists*** **outside** of **V-TFT** (*for the time being*) and the **objects** priority is the **factor** that *determines* which **object** is *drawn over* other **objects** when doing a ***DrawScreen()*** function.

An **objects** draw priority value is set in **V-TFT** and changing this with ***user code*** is not supported by current design.
Most of an **Objects** *properties* settings in **V-TFT** have a ***direct*** affect to how the **Object** will *initially appear* on the **screen** when the **project** is ***compiled*** and *run* on a **device**, so set your **objects** *properties* in **V-TFT** to the *settings* you want them to ***exhibit*** when the **application** is actually ***run*** on a **device**. If an **Object** is *not* ***Static***, you can ***pre-load*** **property** *values* from **user code** ***before*** it is *actually* displayed or *change* them at any time afterwords from ***user code*** to achieve the *desired* **visual** ***effects***. * ***Any object that has another one layered over it still gets completely drawn before the one over it gets drawn. V-TFT does not sort out if any part of an object is not visible due to another object covering any part of it. Every object gets completely drawn based on its properties settings at time of being drawn. Most display controllers do this so fast it is hard to see it happen, but you may notice it at some point with your projects.***

ABOUT EVE FT800 PROJECT OBJECTS:

The **EVE FT800** display controller based devices ***are an exception*** to the **rules** stated above. Its *methodology* for displaying a screens **objects** is handled differently. With the **EVE**, a user makes a change to an **objects** *property* or *properties* that affect its appearance with user code and *then issues* a ***complete*** **screen** redraw *command* to have the change(*s*) manifest on the **TFT**. The **EVE** redraws the *whole* **screen** following a **LIST** of ***drawing commands*** whose ***place*** in the **List** ***determines*** *which* **objects** are **shown** *in front of* **others**. With the **EVE**, the *priority* assigned to an **Object** *actually determines* its **place** *in the* **List** of ***drawing commands***. **But** the **EVE** has the *ability* to ***move*** the *commands* ***around*** in this **list** *also*.
This *ability* is equivalent to changing an **Objects** ***drawing priority value***, which ***is not supported*** during run-time with the other **display** *controllers* supported by **V-TFT**.

In truth, the **EVE** controller would need a ***whole book*** *dedicated* to its **features** and **functions**, so ***I*** am not going to go any further into its *capabilities* **here**, just *this information* to let ***you readers*** **know** that there ***are*** **differences** with the **EVE** display controllers and the original display controllers that **V-TFT** was ***originally*** made to *work with*.

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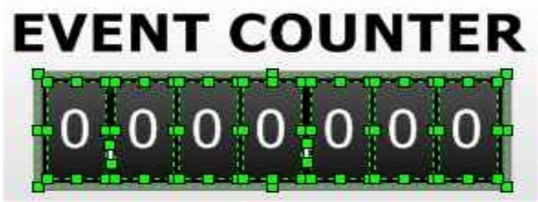
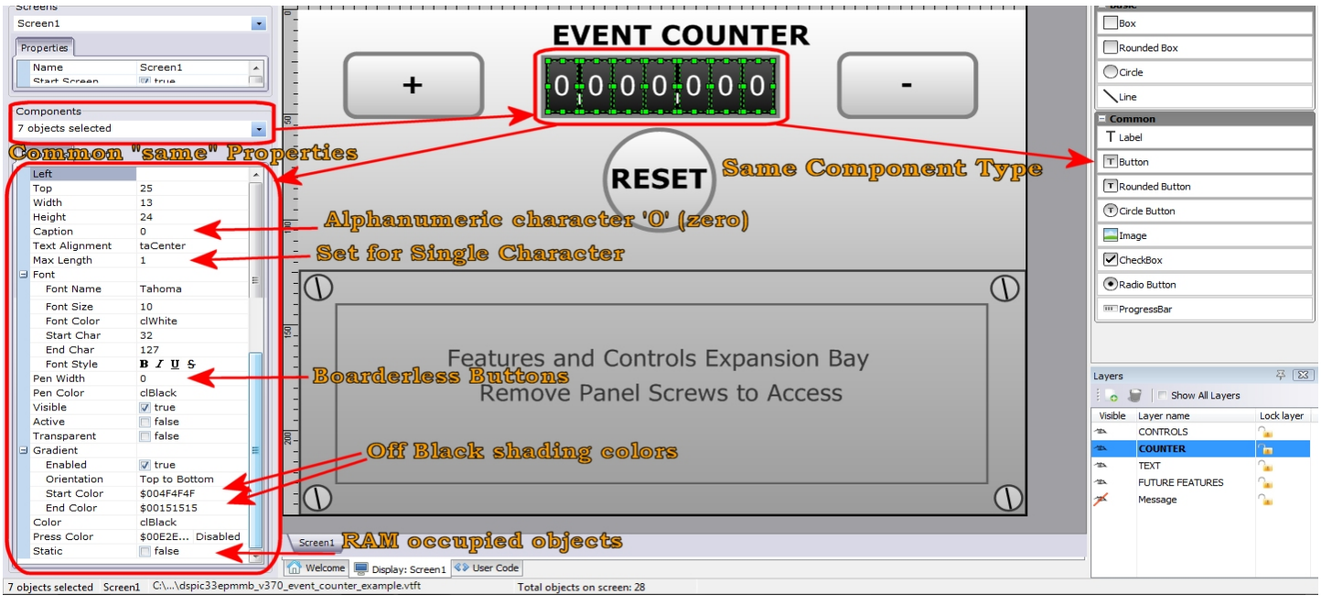
The Objects and Layers used in the Tutorial Example:

The following screen captures show the objects on a layer all selected so their editing outlines are all visible to you.
The Counter Layer has all of the objects used to make the ***digit wheel display-Gadget***.

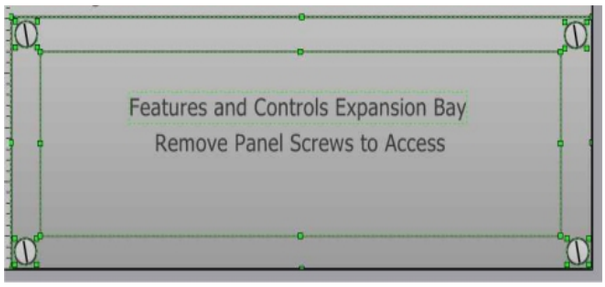


This Gadget is made from **3** different *component types*: **1x Box** , **2x line** and **7x Button** *objects* for a total of **10** ***Objects***.

Each **digit** is displayed by one *Button object*. The picture below shows the **common** "***same value***" *properties* they have.



It requires only *one* routine in the "***User Code***" area to provide its functionality. To change the numbers displayed, the routine "**Event_Counter()**" is called after the variable **COUNTER_VALUE** has been assigned the ***value*** to be displayed.
There is another routine, "**Reset_Counter()**", that manipulates the **Gadget** also, but it is *not required* for the **Gadget** to be *functional*. It just does a fancy zeroing of the display by setting the wheel-digits values to "**0**" one at a time. Setting the **COUNTER_VALUE** variable to **0** before it is called will also work. The fancy manipulations could be integrated into the **Event_Counter()** routine if desired.
The ***Text*** **Layer** has the projects **Label** *Objects* on it.



PRO Tip: *Any time you select more than one (1) Object in the screen editing area, the Component Properties viewing window will change to show only the Properties that have the same settings or values. You can use this to make adjustments to those 'common' properties on multiple Objects all at once instead of selecting each Object one at a time to do so. Selecting multiple Objects with the Mouse is done easily while holding down the "Shift" keyboard key and then left-clicking on an Object in the screen editing area to add or remove it from the Objects selected. The Components Properties window will indicate the total number of Objects selected also.*

The ***Future Features*** **Layer** has **all** of the **objects** *used* to make the lower half of the **screens** expansion bay panel *graphics* (*see image above at left*). The ***Controls*** **Layer** has **all** of the **Objects** that make up the ***three*** (*3*) **TP** *input controls*. If you have the example project in **V-TFT** and *right-click* the ***Controls*** **Layer** and click "*Select all Layer Objects*", you will see that there is ***actually*** **four** (*4*) **Objects** that make up the **three** (*3*) *input controls*. The "***Hidden***" **Object** is a **Circle** *Component* ***Behind*** the "**RESET**" *CircleButton* that is ***inactive*** (*and also set* ***Static*** *as it does not need any of its properties changeable during run-time*), and colored in **RED** and **MAROON** **Gradient** fill colors. ***Normally*** it is ***not*** even *visible*, until the **RESET Button** is *clicked on*, then the ***user-code*** changes the **Transparent** *property* of the **RESET CircleButton** to **TRUE** (*0*) (***Yes*** *a* ***zero is*** *considered as* ***True*** *for the* ***Transparent*** *property of* ***all*** *components,* ***that have it****, the* ***Help File*** *is* ***incorrect*** *and a* ***One*** *(1) is actually considered a* ***False*** *setting, the working running code* ***proves this****!*), so the center of it after redrawing the **Red Circle** and the **RESET Button** (*in that order*) is now **red** ***instead*** of the *normal* ***White-Silver*** **Gradient** colors. The ***user-code*** *flips* the setting of the **Transparent** *property* ***back and forth*** in a *timed manner* to achieve the **visual** ***blinking*** *effect*. (*see the example code listings for how this was done*)

The last **Layer** is the layer for the **message Label** that becomes ***visible*** after the **RESET button** has been ***clicked once***.

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Moving Objects on the Layers Tutorial:

This section will cover moving objects from one **Layer** to another **Layer** and how it will *effect* your *project*.
At some point in time, you will need to move an *object* from the *layer* it is on to another *layer*. Sometimes when placing **Objects** on your *screen*, the **Object** ends up on the ***wrong Layer*** or you find you need to move an **Object** to another **Layer** to make it easier to edit the layout of your screens design. You might find it harder than you thought because there is still a ***minor bug*** in **V-TFT** regarding the **Layers**. I'll show you the ***bug*** and how to get the results you want in this section with these ***step-by-step instructions***.

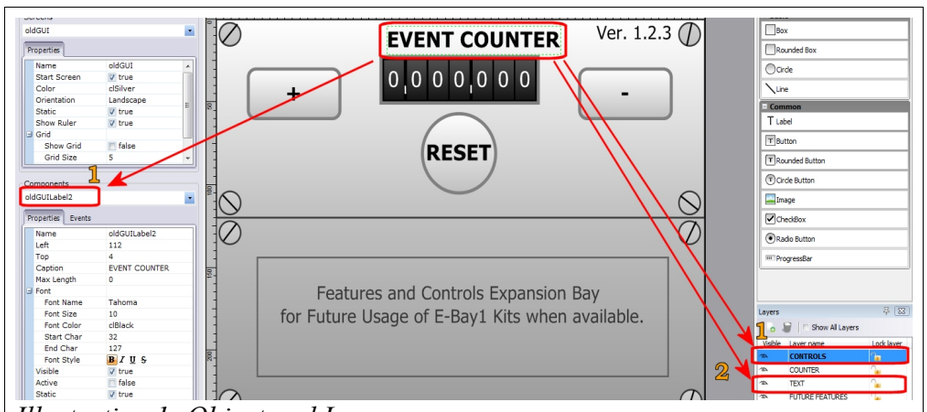


Illustration 1: Object and Layers

For ***example***, the *selected* **Label** "***oldGUILabel2***" is on the *wrong* **Layer** – *CONTROLS (#1)*, and we want it on the 3rd **Layer** – TEXT(*#2*). ***(see #1 & #2 in the Illustration 1 above)***

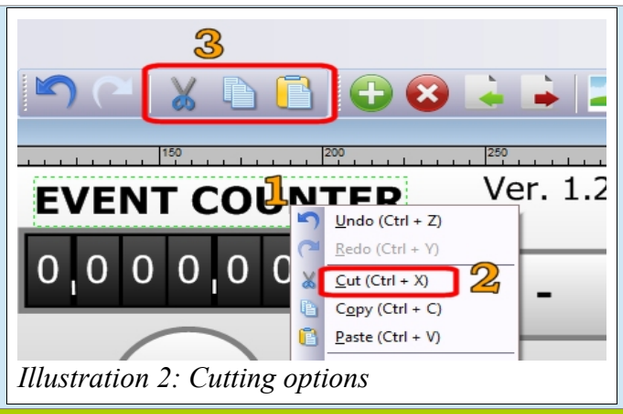


Illustration 2: Cutting options

(see Illustration 2 at left)
If the **Object** is at the front, ***Right-Click*** on it (***#1***) and select "***Cut***" (***#2***), or if the **Object** is hidden *behind* another object- use the tool bars "***Cut***" *button* (***#3***).

(***Illustration 3*** *at right*) Shows the **Object** is now gone (***#1***), and the "***Copy***" and "***Cut***" are now ***ghosted*** out – *so not available* (***#2***).
The **Object** is now in the **Windows** "***Clipboard***" waiting to be "***Pasted***" back into the project (***#3***).

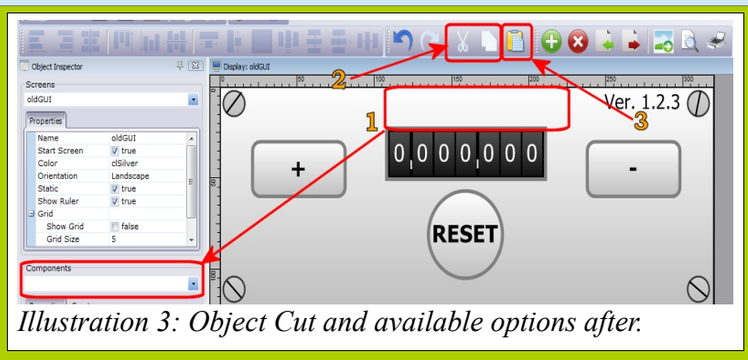


Illustration 3: Object Cut and available options after.

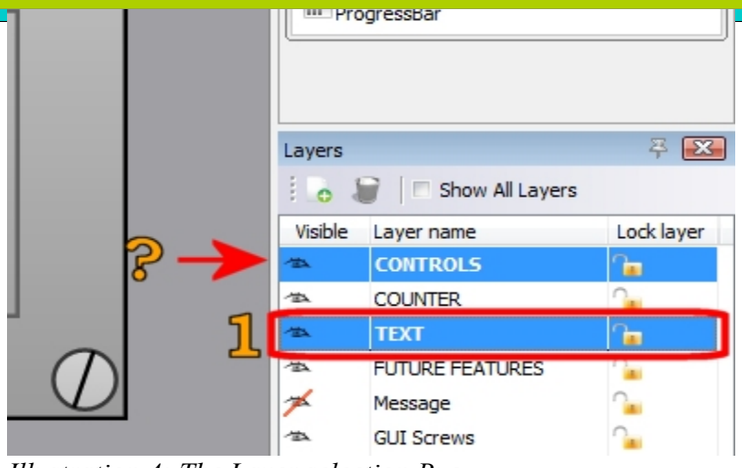


Illustration 4: The Layer selection Bug

So next we need to select the **Layer** we want the **Object** "***Pasted***" to. But here is the where the ***Bug*** in **V-TFT** becomes a *problem*. Follow these steps to get around the **Layer** selections ***Bug*** shown at left in ***Illustration 4***.

If you end up seeing something like the condition shown at left (***Illustration 4***), where it appears there is ***two*** **Layers** selected when you ***left-clicked*** on the **Layer** you wanted to move the **Object** to (***#1 & ?***), you will need to do the following to ***clear*** this *condition* so you can ***paste*** the **Object** on the *correct* **Layer** – **TEXT** (***#1***).

(***Illustration 5***) – First, ***left-click*** on the original **Layer** (***#1***), so the other **Layer** you *want* to ***move*** the **Object** ***to*** is *not highlighted* (***#2***).

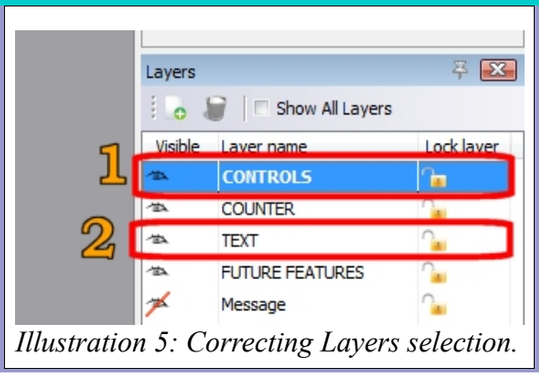


Illustration 5: Correcting Layers selection.

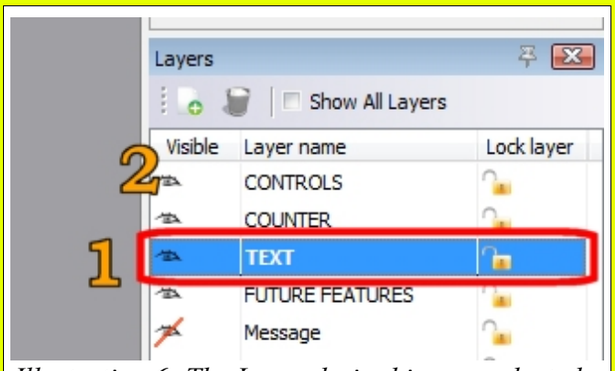
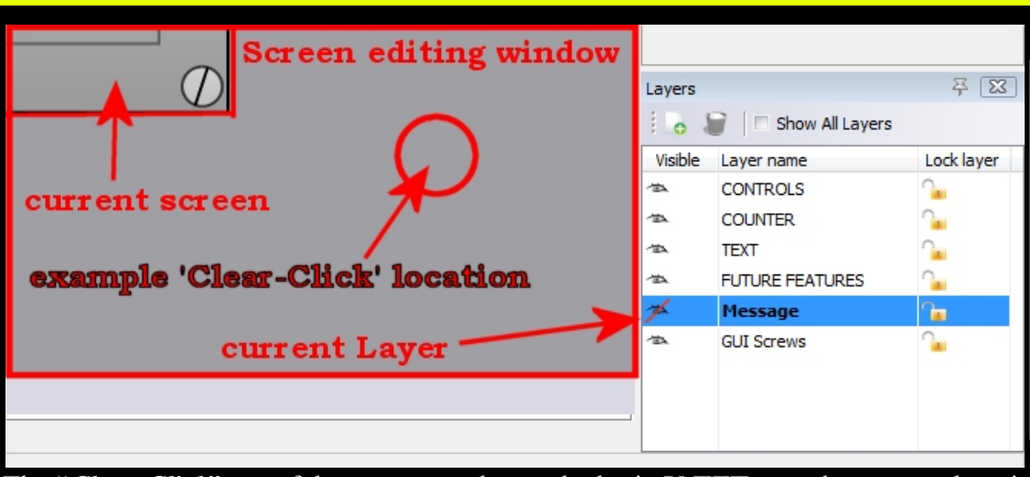


Illustration 6: The Layer desired is now selected

(***Illustration 6***) – Now ***left-click*** the desired **Layer** again (***#1***), and you should see that *only* ***one*** **Layer** is *selected,* and the originally *selected* **Layer** is ***not*** (***#2***).



A quick side note:
I want to establish a ***Terminology*** *for a User Action in* ***V-TFT*** *-*
The ***"Clear-Click".***
A ***Clear-Click*** *action is when you place the mouse pointer anywhere in the Screen Editing Window that is* ***not over the*** *screen being edited and then Click left mouse button so nothing is selected but the screen edit window.*
See image at left

The "***Clear-Click***" use of the *mouse* can be used a lot in **V-TFT** to make sure *nothing* is *selected* and have an *effect* on the out-come of a editing operation. (***It is usually best to Clear-Right-Click in the area that is not part of the current screen you are working on when doing a "Paste" operation. If you right-Click in the screen editing area, there is a good chance the Layer selection will get changed to the Layer the Object you clicked over is on. Where the mouse pointer is at has no effect on where an Object gets pasted. If it was Copied, the new object usually appears low-right of original or some always appear directly over the original Object. A Cut Object should appear at original location. For either operation, the pasted Object should be shown as selected afterwords. The Clear-Right-Click method helps to ensure you get the results you want.***)

Now ***left-click*** in the screen editing window at a good "***Clear-Click***" location (***#1***), so the **Layer** highlight ed's name letters go to **Black** color (***#2***) like shown in ***Illustration 7*** at right. ***(or whatever color you have your V-TFT IDE set at for not selected)***

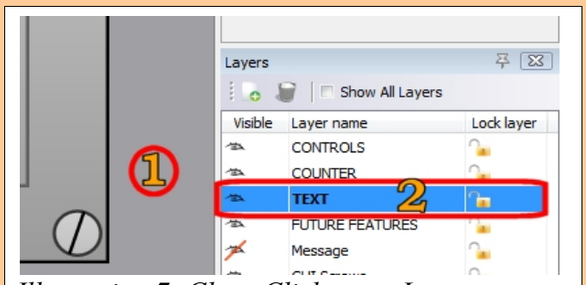


Illustration 7: Clear-Click to set Layer selection.

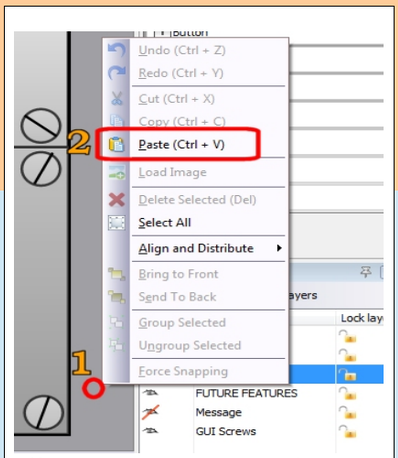


Illustration 8: Pasting the Object to a Layer

(***Illustration 8***) – Now ***Right-Clear-Click*** in a "***Clear-Click***" location (***#1***) and select "***Paste***" (***#2***) from the *menu* to put the **Label** (*or* ***Object*** *you are moving*), on the **Layer** you wanted, as *shown in image to left*.

Or you can use the **Tool bar** ***Paste*** **Button** *also*. (***Illustration 9 - #3*** *at right*)
(***Or Keyboard [Ctrl]+[V]***)

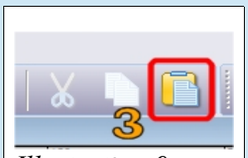


Illustration 9: Paste

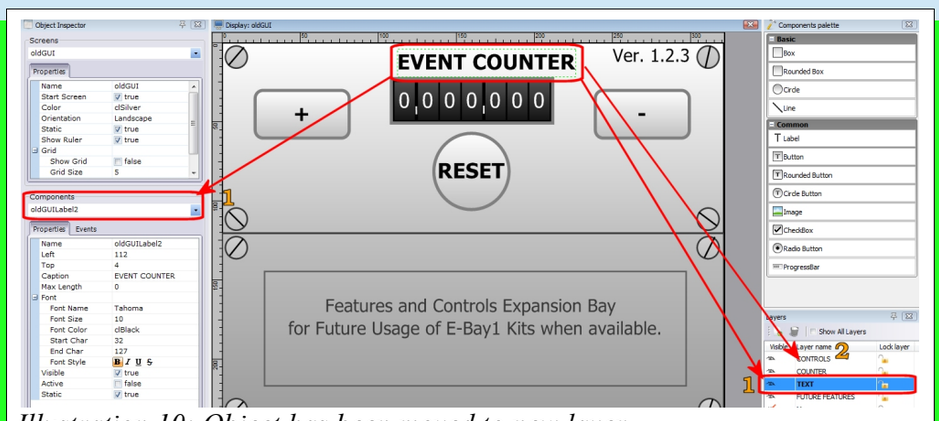
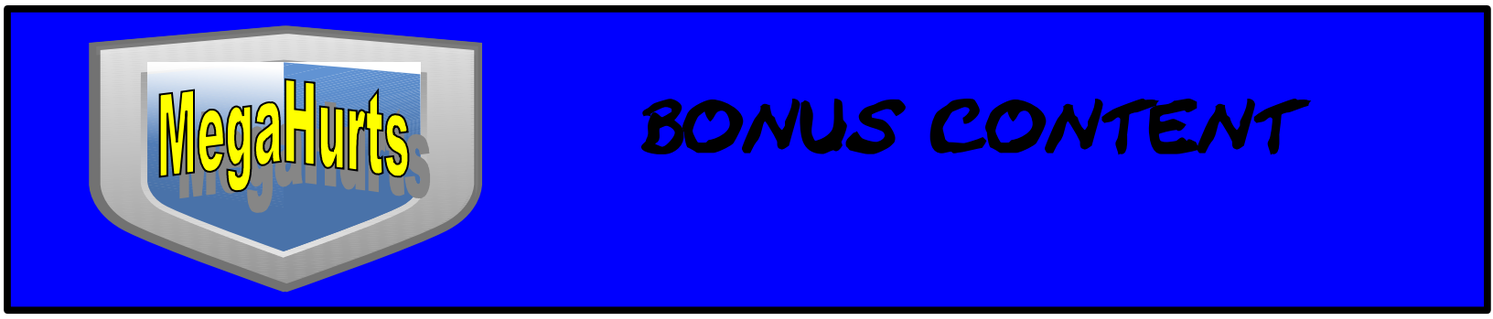


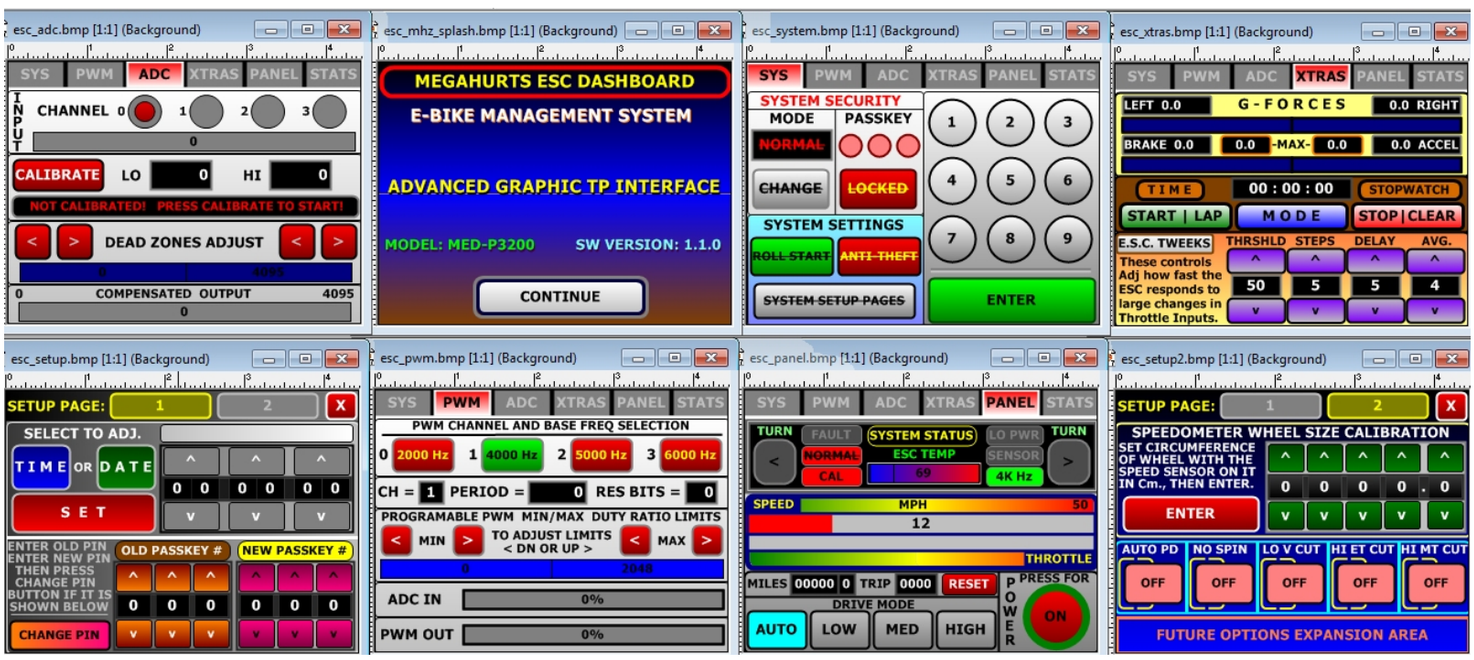
Illustration 10: Object has been moved to new layer.

If everything went right, you should see the **Object** back on your screen and in the *exact* **X/Y** location it was ***at*** when you "***Cut***" it (***#1***), and the name is correct and it (*the* ***Object***) is on the correct **Layer** now (***#2***) like shown in ***Illustration 10*** at left.

Any **Object**(*s*) you move will be ***Top*** or ***Front Most*** *after* being ***pasted*** now, no matter where it *was* in the **Object** *layering* (***Priority***) **list** before being moved. If **it** *has not* happened to you ***yet***, at some point while working in **V-TFT**, you will be moving **Objects** around the **Layers** or putting *copies* of some **Objects** on a **screen** and you will find that the ***draw order*** (*Priority*) is ***wrong*** with the **Objects** ***now*** and you will find you need to be ***clever*** about how you get them sorted so they are all being displayed ***correctly***. I had some cases where I wasn't sure I would get the Layering mess sorted out right without surrendering to frustration and ***deleting*** the problem **Object**(*s*) and making new ones from scratch, because I could not see a workable solution to get things right. *(actually did resort to deleting and using new components, but that was with a very buggy V-TFT version. It has not happened for some time now I am happy to say)*



Because there can be so many possible conditions with *multiple* **Objects** on *multiple* **Layers** and I can't *realistically* cover them all, I had the ***Idea*** to make available a *collection* of **V-TFT** screen exports from a complex personal project I have been working on. I have changed the target hardware from **MMB** for **PIC32** to the **Connect EVE FT800 Breakout board** so had ***Idea*** to let the ***community*** have those **MMB** screens as **Object** ***Layering*** on *multiple* **Layers** ***examples*** to aid those who want more examples on this **topic**. The project they came from was for a *custom* ***Electric Bicycle Brushed DC Motor PWM Electronic Speed Controller (ESC) and Graphic System Management TP GUI***. *I think there is 9 or 10 screens in the collection.* ***(more than shown in the image below)***



Click on image to download the Collection from Libstock.

All screens and controls and indicators are made from **V-TFT Objects *only***. **No** *BMP's* or *direct draw* **TFT** *instruction codes* ***used***. Lots of custom made input controls using different methods and custom indicators for data output using different methods too. All designs are my own that I worked out while I was learning how to use **V-TFT** and ***Bug test*** it for ***MikroElectronika***. My work on these screens has led to ***many*** *changes* and *improvements* that are now a part of the **V-TFT** you are using and how it now takes *less work* to make screens like these. So ***I feel*** they are of **some value** as tutorial *examples* and you should consider taking a ***look*** at them.

Sorry, but you won't get any program code* with them though, just the **Objects** on each screen as I have them organized on the **Layers** and how they are ***layered*** and all of their *properties settings* I used to make them as they are. If you want to examine them, download the ***zip*** package from this tutorials **Libstock** page and un-zip the download. It makes a folder with the screen files (*.scr*) and a ***bmp*** image of same name for each screen to *preview it*. Start a new project in **V-TFT** and then ***import*** any screen you want to examine or copy any **Objects** from to your own project(*s*) and use. You can change any **objects** *properties* as you want. **(the ESC code is still in development and may become a commercial product, so I have to keep it secure for now)*

I warn you though,
you just might have ***FUN*** trying ***(or surprised)*** to find out how many objects any control or indicator really uses.....

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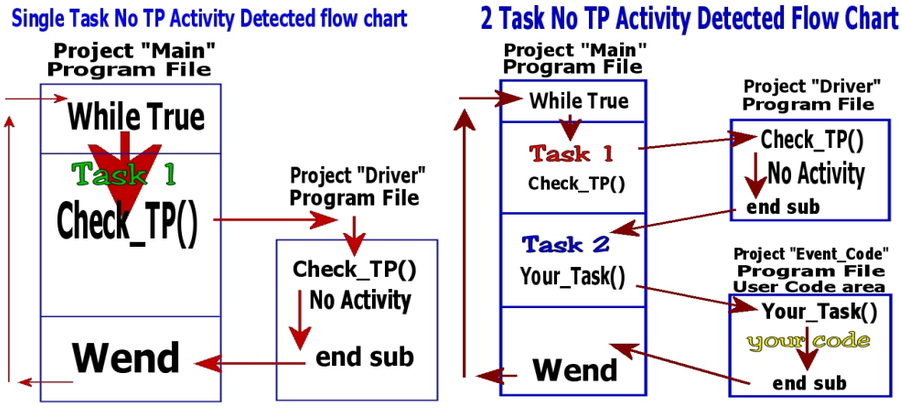
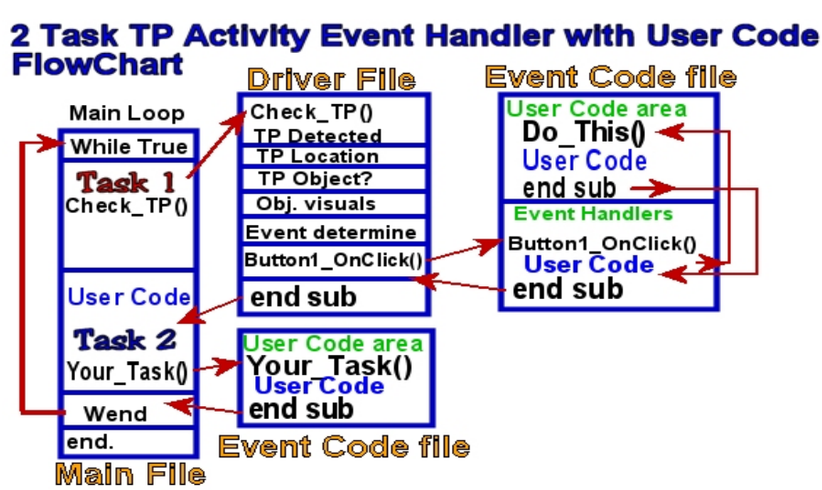
The MAIN Loop and Multitasking in V-TFT Flowcharts

These Flowcharts show the program execution flow after the Main Loop in the main program file has been entered for a single Task and a double Task Framework with no TP activity and a 2 Task with TP activity program flow.

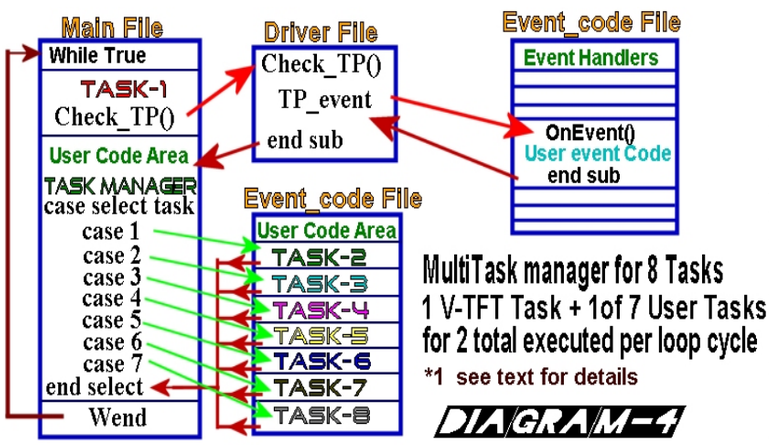


These two flowchart diagrams show the basic program execution flow for the initial **V-TFT** project that is not modified by *user code* for adding an additional task in the ***main loop*** (*left chart*), and program flow for adding a "***User Task***" code routine (*right chart*). Both also show the program flow without any **TP** activity happening. Once a **V-TFT** project program execution reaches the ***main loop*** and executes the **call** to the "**Check_TP()**" *routine*, the **call** *MUST* be able to be ***completed***, otherwise the **TP** will not respond when user tries to use screen controls. The **call** to any *routine* requires some *information* be placed on a '**Stack**' for later restorations for ***Returning*** from **call** and also *cleared* from the **Stack**. So not letting a **call** to a *routine* be ***completed*** **reduces** the amount of **stack** *memory* other **calls** and **operations** have ***available*** to use. Not properly managing the **Stack** is a easy error for programs to experience, as the devices have a *very limited* amount of **Stack** *memory* to start with.

Not all programming *errors* that can cause **Stack** overflow *errors* can be caught by the **compilers** during a **projects** *compiling*. These are called "***run-time***" *errors,* since they are only *apparent* when a **program** is **run**. This information is to let you know about the first possible ***error*** condition your "***User Code***" program *logic* can cause if not coded *correctly*. If you override the **V-TFT** main routine **call**, by using your own *routines* or your *routines* **call** it from within a **TP** object event-action handling routine, possible stack overflow issues arise.



This **flowchart** shows a simplified example of the main loop pass with Touch Panel usage detected. The ***user code*** for the **Obj**. ***event handler*** *routine* has a task done by another ***User Code*** *routine* also. Depending on the **MCU** being used, the number of routine calls you can '***nest***' in the first one, (**Check_TP()**) from the **"main"** may be too much of a restriction for your design to work. **All** *routines* **must** complete their invocation to **clear** off the '*stack*' markers to prevent ***overflow*** *errors*.
Check the number of levels deep your project gets in your compilers '**Statistics**' Function Tree tool after a successful compile. You can see the nesting of routine calls with that tool to spot badly placed calls nesting. You should examine a new projects structure before any user code is added to see what is a normal structure. **This** *Flowchart* ***best*** illustrates ***how this*** tutorials *example project* **is coded** to run.



These ***Flowcharts*** show the basic's of the **V-TFT** project *Template Framework* and *flow structure*. These are not the *only way* a user can configure the flow structure. But no mater how you configure your design and the tasks your code does, it needs to provide the equivalent of the program flow demonstrated in these ***Flowcharts*** shown here.
If any part of your "***User Code***" breaks the chain of the required **V-TFT** "***Check_TP***" execution pass's, your application will ***fail*** to work or ***freeze***. Program code must be capable of allowing this continuously repeating execution of routines of *Both* **V-TFT** and **User Code** to *cycle* without the code preventing the exiting of any routines in the loop.

There can be many **Tasks** in the main loop that execute one after the next *and/or* you can have **Task** selecting management code to call **Tasks** only if criteria is met. The **V-TFT** ***Template*** does provide a ***powerful*** and ***flexible*** *Framework* for users to create applications with, if the framework is used in a proper way.

The *Tutorial* **V-TFT** example application provided has a slightly different flowchart than any show above, *But it follows the rules and requirements of the Template framework still*. This framework description is just a way to introduce you to the concepts that **V-TFT** employes and give **you** a ***solid knowledge base*** from which to work with.
Keep it in mind and you should have no problems making your project ideas work if you build from this template concept.

***1**(The task manager code can either increment thru the Task numbers itself so only one of the 7 User tasks plus the Check_TP() task gets executed per cycle of the main loop in order set by select case coding. Or the Task variable that tracks which is scheduled gets modified in "User Code" routine code or user code in event handler routines or by code in each User Task routine code for smart task scheduling based on each tasks actions done.)

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Project Files "User Code" Template areas:

Where they are and example usages in mikroBASIC Pro.

Over View:

Visual-TFTs output is code that is organized by Templates V-TFT is programmed to follow. What code is generated is determined by what Objects there are in a Project. Each object's related code structures are a Template, even the related code to instruct the display controller how to draw an object. Once there has been an object used in a project, the Template of all code needed to handle that object type is included in the output.
Most of the code generated by V-TFT goes into the files; projectname_driver , projectname_objects and projectname_resources. These files are regenerated in V-TFT every time the project is saved or built and all code is first erased then built up by V-TFT placing the required templates of code needed for the elements a user has made their project with. So those files are not considered "safe" for User Code. The framework that V-TFT molds the templates of code to has designated areas for users to place their code that completes the architecture of the application and makes it functional.
For Visual-TFT versions 3.7.0 and older there are 2 files in the V-TFT projects template that are files a User can place their own "*User Code*" in that can be done with little worry it will get overwritten. They are always made by V-TFT for any supported hardware and in the compiler language selected for the project.

There is another place users can place code safely also – their own module(s) files. This Tutorial does not cover the usage of "Users Modules".

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Project Events_Code File:

**The first one is the V-TFT projects '*Events_Code*' file. This is a '*Program Module*' file for the project.
This file provides User Code areas to declare Variables and Constants and to place your subroutines and sub functions that can be called from your code in any objects Event Handler routine created.
As the files name says, this file is the one V-TFT uses to place an objects assigned "Event Action" routine(s).
The order the Event routines appear in the file is determined by the order you assigned Events to your Objects in V-TFT. These assignments MUST be done in V-TFT so all Template code and pointer assignments are set correctly in the output code in the Driver file.**

This version of the tutorial manual has BONUS Code variations that are optimized and make use of the counters objects structures pointers for better manipulations of their caption properties done by *Aleksandar Vukelic.*

You can compare the two ways the same thing gets done and get some insight into the workings of V-TFT.

Here is what a new blank V-TFT projects "events_code" file looks like before you add any components to the projects screen.

```
module sample_blank_vtft_code_events_code

include sample_blank_vtft_code_objects
include sample_blank_vtft_code_resources
include sample_blank_vtft_code_driver

        OFF LIMITS AREA

'---------- Externals ----------'

'---------- End of Externals ----------'

'---------- User code declarations ----------'

'---------- End of User code declarations ----------'

implements

'---------- User code ----------'
```

Projects module File name.

Linking other modules to this project.

These areas that are light-Red in color are places you cannot place your code.
If you place any code in these areas, you will cause the V-TFT program to lose track of where your "User Code" should be, and usually ends with your project not working.

This area is new with V-TFT Ver. 3.7.0 and not documented. Any code I have tried placing here (not a external declaration) got erased when project build was done.

OFF LIMITS AREA:

In these areas, Do Not Modify the Comment Lines V-TFT makes or your Code might get erased!

1st User Code area available in a V-TFT projects "event_code" file.
This is where the variables and constants you will be using in your project get 'declared'. (*See actual Example Code for example usage*)

OFF LIMITS AREA:

– **Start** of YOUR **2nd** '*Safe Code Area*' for your Applications Routines.

You need to organize your projects tasks so they can be encapsulated inside of your "User Code" subroutines and this area is where many of them are going to reside.

```
'---------- End of User code ----------'

' Event Handlers

end.
```

OFF LIMITS AREA

–This starts the area that **V-TFT** places code templates to declare the Routines assigned to any objects Event-Action and where you will put your code to perform the task(s) you want to be done for the Event triggered.

Event Routine Template
sub procedure ObjectName_OnAction()
[*your User Code for Event task here*]
end sub

The space between the last "**end sub**" and the "**end.**" file termination Label is subject to being overwritten by templates of any new Objects Event-Action handling routine. Only comment lines should be placed here until editing in **V-TFT** is done.

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Project Main File:

The second one is the '*MAIN*' program file *every compiler* project needs. While this file is required, it contains only 2 V-TFT routine calls, Start_TP() is a one-time-only call before the endless loop and Check_TP() gets called every pass of the loop. The rest of the file is empty of code and only has some V-TFT made comments about the project at top of file. Even though there are no V-TFT comments indicating any User Code areas, this whole file can be considered as usable for "*User Code*", if used correctly as the V-TFT project template expects. This example projects comments will show you the organization of the template.

Warning! This file will be completely overwritten anytime you change the Hardware Profile to use in the projects Options. This issue applies to Visual-TFT Version 3.7.0. and may get changed in a later version.

Here is a sample of a blank projects "Main" program file listing as it would look to anyone, no matter almost the language programmed in.

```
' *
' * Project name:
'     sample_blank_vtft_code.vtft
' * Generated by:
'     Visual TFT
' * Date of creation
'     10/30/2013                    ' V-TFT generated comments about the project and hardware it was
' * Time of creation                 ' intended to run on.
'     8:44:10 PM
' * Test configuration:
'     MCU:            P32MX460F512L
'     Dev.Board:      MyMikroMMB_PIC32_hwRev_1_10
'     Oscillator:     80000000 Hz
'     SW:             mikroBasic PRO for PIC32
'                     http://www.mikroe.com/mikrobasic/pic32/
' *
program sample_blank_vtft_code_main   ' program name declaration.
                                      ' Symbol declarations would go here
                                      ' Variable declarations would go here
                                      ' Constants declarations would go here
                                      ' Sub Procedures declarations would go here
                                      ' Sub Function declarations would go here
                                      ' Interrupt Service Routine(s) (ISR) would go here.
main:                                 ' Label: main program starts here
                                      ' User code can go here: Gets executed one-time-only.
  Start_TP()                          '* Required V-TFT routine call to do HW Initializations, calibrate the Touch Panel....
                                      ' User code can go here: not in the main loop (yet). Gets executed one-time-only.
  while TRUE                          ' Start of the "main loop": ALL code after here gets executed repeatedly.
                                      ' User code can go here: IN the main loop, so gets executed repeatedly.
    Check_TP()                        ' The heart pulse of a V-TFT project: this calls the routine once every loop pass.
                                      ' User code can go here: IN the main loop, so gets executed repeatedly.
  wend                                ' End of the main loop: program flow repeats at "while TRUE" statement line.
                                      ' Nothing here. Just empty space
end.                                  ' End of the program file
```

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Project File Areas by the COLOR's

To help make clear the different parts and areas of the Project Template code generated,
The User Code areas and the V-TFT code areas backgrounds will be differently colored.
These project code files listings have a coloring scheme of the background colors as follows:

V–TFT Generated Program Code Colors Key

V-TFT Template generated Program Code.

V-TFT Template generated Event Handler subroutine Code.

V-TFT Template generated Program Comments.

V-TFT Template generated AREAS – Comments – Code That are crucial, and should not be modified!

The User Code Colors Key

The Examples Tutorial Comments.

The Examples User Code Declarations

The Example User Code Program Code

The Example Event Handler User Code

Open to use for "User Code"

Event Counter Program Main File code Listing

```
' *
' * Project name:
'     pic32mmb_v370_example_tutorial.vtft
' * Generated by:
'     Visual TFT
' * Date of creation
'     10/18/2013
' * Time of creation
'     2:51:18 AM
' * Test configuration:
'     MCU:            P32MX460F512L
'     Dev.Board:      MyMikroMMB_PIC32_hwRev_1_10
'     Oscillator:     80000000 Hz
'     SW:             mikroBasic PRO for PIC32
'                     http://www.mikroe.com/mikrobasic/pic32/
' *
'   Original Programming and Tutorial comments done by Robert Townsley
'   Alternative optimized code versions in 'events_code' file by Aleksandar Vukelic
'
' * Program Description:
'   This is a V-TFT example project by Robert Townsley (MegaHurts), to show how
'   to make a simple lab instrument event counter that can count up to 9,999,999
'   events. It can be modified to count higher by any body that has a need to do so.
'   This V-TFT example project also shows how to use multiple components to create
'   what looks like a single screen indicator object. The indicator object was designed
'   to look like a mechanical multi-wheel numerical counter. The indicator object
'   uses seven Button components to display a single digit each of the events total
'   counts in order to get the appearance of a mechanical wheel counter.
'   I did not attempt to program any wheel digit rolling to the next higher digit value
'   in this example project. That is beyond the scope of this demo/example.
'   (The wheel counter looks pretty good as is anyway)
'
'   This V-TFT project also shows how to make a proper user code single pass
'   routine get called from within the main endless loop that V-TFT sets up in
'   this module to drive its TP checking and event handling core code.
'   Or you could call it a 'How to share the loop' example.
'   It demonstrates how to do this and have it manage the RESET buttons visual
'   effects to show confirmation is required before a counter reset gets done by
'   calling a routine located in the events modules "User Code" area from the
'   loop here when it is needed to do so. It also shows how to add confirmation
'   safety to any button press method.
'
```

```
'
'   You are invited to examine this projects code and screen components in V-TFT
'   and a compiler in order to see how it all gets done, and use the knowledge you
'   get from it in your own projects or you can take the simple work done here and
'   use it as the base for making a more complex feature filled application to suit
'   your needs or just to experiment more on. Your choices, you do as you want with it.

'   So I hope you take the time to read all of the comments, and that they help you
'   to a better understanding and usage of MikroElektronika's Visual TFT software.
'   If you find anything hard to read, understand or confusing to you,
'   please let me know, post a comment on its LibStock code page or forum thread.
'       Best Regards to all, Robert.
'
' * Note to users of MikroC and MikroPASCAL languages:
'   Sorry, but I do not use those compilers so MikroBASIC versions are all I can
'   make for now. I may someday add PASCAL to my arsenal, but not C. Sorry, but
'   I just do not like that language, and never have (any version). But you users
'   of those others should be able to understand what is going on in BASIC in this
'   project without too much trouble, and more so for you PASCAL users, not much
'   difference between them really. The coding is simple and the comments apply
'   to all languages as for how V-TFT is organized.
'
program pic32mmb_v370_example_tutorial_main

 Users code can go any where in this module as long as its placement follows the
' compilers rules for a programs organization layout that is always in effect.
' New users to V-TFT may at first be confused by this very plain, bare almost,
' MAIN program file and its lack of all the normal coding you were expecting.
' With V-TFT projects, the main file is left bare so users can still have a place
' to do their coding in, but it will have to be done a little differently than
' some of you are familiar with in order to work without breaking how the V-TFT
' generated stuff works. Please read all of the comments in this file for more
' detailed instructions about this.
'
' User Symbol defines can go here, but they will only work in this module.
'  (see compiler help file or manual for more information on symbols and program organization)
'--------------------------------------------------------------------------------

' Users Variables declarations can go here.(global)
' (see compiler help file or manual for more information on variables)
'--------------------------------------------------------------------------------

' Users Constants defines can go here.(global)
' (see compiler help file or manual for more information on constants)
'--------------------------------------------------------------------------------

' Users subroutines coding can go here.
' (see compiler help file or manual for more information on subroutines)
'--------------------------------------------------------------------------------

' Users Function routines can go here.
'  (see compiler help file or manual for more information on function routines)
'--------------------------------------------------------------------------------

' Users ISR routine(s) go here.
' (see compiler help file or manual for more information on Interrupt Service Routines)
'--------------------------------------------------------------------------------

' Start of main program body. Program execution begins at the first instruction
' after the "main:" label marker and proceeds downwards towards the "end." label.
main:

' User code here gets executed one time only on power up
' or after a reset because of endless loop below.

' User variables initialize. (these variables are declared in events module)
COUNTER_VALUE = 0     ' set value to zero
RESET_FLAG    = 0     ' clear flag state
BLINK_TIMER   = 0     ' set value to zero

Start_TP()  ' Generated call to initialize HW and V-TFT screen(s) and objects.
            ' The routine called is in the 'driver' module and it calls on
            ' other routines in the driver module before returning program
            ' execution flow back here. It is only called once per
            ' device power-up or after a hard or soft restart (reset).

' main program endless loop section begin
while TRUE

    ' V-TFT makes this endless loop as part of a V-TFT project. It is
    ' a important part of how a V-TFT program executes. Once program
    ' execution flow enters this loop, it never can exit it, and
    ' should not, so do not change the loop set up or put code that
    ' will cause program execution to exit it out the bottom.
    ' If it does, the application will enter a continuous NOP loop
    ' state (at the 'end.' statement), and become 'locked up' and
    ' unresponsive to any input.
```

Remember: This color shows the open for “User Code” areas.

Start of Program execution flow during run-time.

Routine Call: Start_TP() in Projects Driver Module

V-TFT core code in Driver Module to initialize HW and SW V-TFT Objects, Resources and Screens.

This gets called One (1) time Only on power-up.

Return From sub Routine: end sub

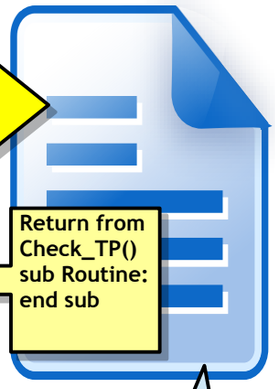
```
' A RESET will be required to restart the
' application every time it does so.
'*  ANY code put here should be of the single pass execution design
'   and allow program execution to continue on back here in a
'   timely manner or the program might appear locked up or actually
'   be locked up and non responsive.
```

Program Loops to First instruction after 'while TRUE'

Check_TP()

REPEATING TASK Routine Call: Check_TP() in Projects Driver Module

Return from Check_TP() sub Routine: end sub



Represents Driver Module Code and possibly User Event Handler Code in Events_Code Module before returning back to this Main Program Module Code.

```
' This routine is what will call your code in a screen object event handler
' routine when TP activity triggers the need to be handled by a predefined
' event condition you set in V-TFT for an object.
' Once all of the code this routine has execute and any event handler code you
' program in is done, program execution flow returns back here to the next
' instruction after this one. That may be your own routine call or if no user
' code is present, the "wend" statement will cause another pass of this loop
' to start again, and so on and so on and so on.....
'*  This routine call must be allowed to execute repeatedly and as quickly as
'   possible so TP activity can be detected. So be discreet with your code you
'   place in this endless loop. If your program seems to be locked up or not
'   responding correctly to TP input, check any code you have placed here.
'
' Routine(s) can be called that are either coded above or in the events module
' or in a user made module from within this loop that will perform HW controlling
' or checking the MCU's HW Analog or Digital Inputs for changes or new data and
' if needed, call other routines to do actions based on what has changed or the
' new data in. But they must allow program execution to resume back here after
' doing the task programmed. By placing your routine call(s) or other code here
' in this loop, you are 'sharing' CPU processing time with the V-TFT core
' code, so share nicely. The time taken by the V-TFT Check_TP() routine will
' vary depending on TP activity and number of screen objects to test
' and the code YOU program in the event handling routines and so on. . .
' So any code you program in the event handling routines if done wrong can also
' cause an application lock up if it does not allow execution to return here
' for another pass of the loop.
'
' For this example project, if anyone wants to add the ability for the
' counter to be triggered by a PORT pin set as input instead of the UP & DOWN
' buttons on the screen, you place a call to a routine that reads the
' PORT here in this loop, after you make the routine that does the PORT
' reading. Also in that routine, you have it add 1 to the variable
' "COUNTER_VALUE" and call the routine I made that updates the screen
' counter object "Event_Counter()", and it will update the screen to
' the new value after it checks for roll-over condition @ 9,999,999 counts.
' My update routine will return program execution flow to the next statement
' in your routine after the call to it when done.
' Your routine for reading a PORT can be located above (where I indicated with
' a comment, area for user subroutines and functions), or in the "User Code"
' area in the 'events' module file where indicated for User Code or in a
' module file of your own making.
'
' The following code is an example of using this loop in a sharing way with
' the V-TFT core code. The code here calls a routine coded in the events module
' located in the "User Code" implements area.
' On every pass of the loop, the variable RESET_FLAG is checked to see if
' it is not equal (<>) to zero value. If it is equal to zero - nothing else
' happens, program execution goes to the while loops 'wend' instruction
' and the looping starts over again at the first instruction after the
' 'while true' statement.
' Event handler routine code in events module will change RESET_FLAG's value
' when the RESET button on the screen has been clicked. If RESET_FLAG's value
' is zero (0), it will be changed to a one (1) value, or if it is at the value
' of one (1), it will be changed to a value of two (2). A value of 1 or 2 will
' cause the test code below to evaluate as TRUE, so the routine Reset_Counter()
' will be called every time the loop repeats while RESET_FLAG is not equal to
' zero. In the codes logic design, the Reset_Counter() routine can be called
' many times when RESET_FLAG = 1 because a waiting condition for a second click
' of the RESET button exists then. So the Reset_Counter() routine will blink
' the RESET button red to indicate the waiting-for-confirmation-click state
' while RESET_FLAG = 1.
' But after user clicks the reset button a second time, RESET_FLAG is set to a
' value of 2 by the RESET buttons on_Click() event handler routine and when the
' Reset_Counter() routine is called again, it will detect the next state change
' and clear the counters counting variable (0), clear the RESET_FLAG variable
' (0), and set all 7 wheel digits to "0" and reset the blinking timer variable
' for the next time the RESET button is clicked on, resulting with only a
' single call to Reset_Counter() routine when the RESET_FLAG variable is equal
' to two (2). After the call, the RESET_FLAG will be back to zero value again
' and the "if-then-end if" conditional test below will fail and not call the
' Reset_Counter() routine again until RESET_FLAG changes.
' This setup will result in a varying amount of time the User Code will take
' of the processor, and may become apparent with some of the screen updates
' and/or responsiveness of the TP to inputs when different amounts of user code
' is being executed in this way.
' To balance this and keep everything looking and acting like there is no
' imbalance of V-TFT core code vs User Code, the 'if-then-end if' test below
' could be modified so that when RESET_FLAG = 0, a small delay instruction is
' executed that simulates the amount of time the Reset_Counter() routine would
' take if it were being called. This is probably not required for this
' application and is not the best method to keep things looking and running
' balanced. I am not going to go into those other methods for this example
' project, but wanted to point out that there are timing factors to be
' considered and managed once you start sharing the processors time for V-TFT's
' core code by putting your code in this loop. A lot of tasks can be done by
' this method and some may require it to be done this way while the controlling
' of some MCU's hardware will require a more advanced method using timer
' interrupts to keep the timing of the code as required for the HW controlling
' to work.
```

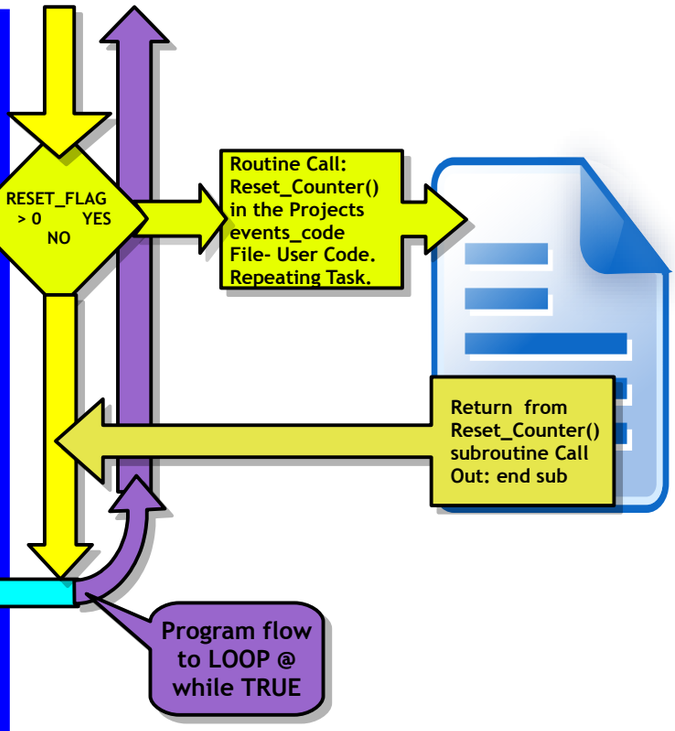
```
' I will try to make an example project that demonstrates that method in the
' maybe near future or sooner if a lot of requests for it I get.

'* user code for sharing V-TFT endless loop to get repeating passes of execution
'  on some user code that is of single-pass execution design.

if (RESET_FLAG > 0) then
   Reset_Counter()
end if
                    ' call this routine if the RESET_FLAG variable is not
                    ' equal to zero which is the indicator that it (screen
                    ' RESET button), has been clicked at least once.
                    ' On first click, flag is set to 1 and Reset_Counter()
                    ' routine will cause a message to appear and the RESET
                    ' button to blink* between its normal colors and red
                    ' and maroon colors until it is clicked again to
                    ' confirm reset wanted (RESET_FLAG now set to 2), or
                    ' user presses MINUS (-) button to cancel
                    ' (RESET_FLAG set to 0 - cleared) and the count total
                    ' is not lost.
                    '* See the code and comments in Reset_Counter()
                    '   subroutine to see how this effect was done.*
wend
                ' end of while loop, because configured as endless loop,
                ' this makes program execution flow go to the next instruction after the
                ' 'while true' statement.

goto main       ' EOF trap. Prevent execution to end, jump to main to start over

' End of main program code and file.
End.
```



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Event Counter Program Events_Code File code listing

```
module pic32mmb_v370_example_tutorial_events_code

include pic32mmb_v370_example_tutorial_objects
include pic32mmb_v370_example_tutorial_resources
include pic32mmb_v370_example_tutorial_driver

sub procedure ButtonRound_MINUS_OnClick()
sub procedure ButtonRound_PLUS_OnClick()
sub procedure CircleButton_RESET_OnClick()
'---------------- Externals ----------------'

'---------------- End of Externals ----------------'

'---------- User code declarations ----------'
'
' This area should be used to declare your "User Code" routines forwards for
' those routines that need to be called from outside of this project module.
sub procedure Reset_Counter()   ' forward declaration so the calls from the main
                                ' program file to it will work.


' This area is where users variables and constants are declared and defined
' that will be used by users executable code in users own routines or the
' routines V-TFT generates for screen objects touched event handling in
' the area below marked as "Event Handlers" because users must supply the code
' to be executed in those event handler routines.
' V-TFT just makes empty routine declarations for you, the user/programmer.

' User Code variables (GLOBAL)
dim COUNTER_VALUE as longword   ' variable to hold counted events total
    RESET_FLAG    as byte       ' variable for tracking RESET button clicks
                                ' and Reset_Counter() routine operations
    BLINK_TIMER   as byte       ' variable for counting number of passes in
                                ' Reset_Counter as time control for blinking
                                ' colors of RESET button.

' User Code constants (GLOBAL)
const bTRUE   as byte = 1       ' constant for setting or testing a logical
                                ' One (1) True state
      bFALSE  as byte = 0       ' constant for setting or testing a logical
                                ' Zero (0) False state
      BLINK   as word = 200     ' change value to adjust rate RESET button
                                ' blinks colors. Lower = faster, Higher = slower
                                ' when BLINK_TIMER value gets greater than
                                ' this constant, RESET button colors change.
```

Project Module Name

Linking Other Project Files

V-TFT puts a forwards declaration here for every Object Event Action you set

External Declarations go here. These point to Identifiers in other modules.

Aleksandar's alternate code using pointers declaration goes here:

```
const digits as TButtonPtr[7] =
(@Button_One, @Button_Ten,
@Button_Hundred,
@Button_Thousand,
@Button_TenThousand,
@Button_HundredThousand,
@Button_Million)
```

```
'---------- End of User code declarations ----------'

implements

'---------- User code ----------'
```

OFF Limits areas!
Do Not Modify!

```
' User code that is located below the "implements" statement must be of a
' sub procedure or sub function routine nature. Program execution is not allowed
' to just follow the 'TOP-to-BOTTOM' flow like it does in the Main program file.
' All code here is contained within either a sub procedures or a sub functions
' routine starting and its ending declarations and is called on from either
' V-TFT core code (event handler routine), or user code in an event handler
' routine or from user code in the 'main' program file.
' Program execution flow inside the routines DOES flow 'TOP-to-BOTTOM', but must
' encounter a 'end routine' statement so execution point goes back to the
' instruction after the ONE that called the routine.
' (If your routines coding (logic) does not allow program execution flow to exit
'  the routines in a timely manner, your application might appear to be hung-up or
'  slow to respond to inputs or other HW you are trying to control does not work
'  like it did in a different example that you tested.)
'
' The code a user places in this area is safe from V-TFT overwriting as long as
' nothing is done to the beginning/ending User Code comment markers.
' V-TFT does rewrite all of the code in the driver and objects files every time
' you have made any changes to any objects used in your project, so doing any
' code editing in those files is not recommended unless you do it in a compiler
' and will not be loading it back in to V-TFT again.
'
'* Other modules may require that any routines coded here also have an associated
'  'Forwards' code line placed in the User Declarations area above in order to be
'  'visible' to that and other modules. All V-TFT generated event handler routines
'  will have a 'forwards' declaration automatically added to 'externals' area above
'  the 'User Declarations' area, so users only have to declare a routines forward if
'  they write their own and it needs to be visible to other modules in the project.
'  V-TFT will take care of this automatically for all routines it generates and needs to.
'
'--------------------------------------------------------------------------------
'
'* Note from the Author;
' V-TFT Users, You can use the objects that make up the counter (copy them to
'  your project), and copy this entire sub procedures code also to your V-TFT
'  project to easily add this custom numerical wheels display to your design,
'  as is, or modify it to meet your needs of more or less digits displayed.
'  Just make sure the naming matches between code and objects and you will need
'  to also declare a global Variable named "COUNTER_VALUE" (longword type), to
'  hold the value you want to be displayed when you call this routine, (the way
'  it is coded now), or change this sub procedures declaration so value is
'  passed as argument to it and you can use what ever variable name in your
'  projects code to accumulate a value you want displayed by this custom wheel
'  digital display.
'
'  I hope you reading this and looking this example project over have found it
'  useful and easy to understand how it works or at least gotten something useful
'  from it to spark your own creative design ideas to do in V-TFT.
'  This is the best way I have found to share or acquire custom components so far
'  for V-TFT.
'  Use any combination of objects to make a custom display gadget or TP
'  input/control/indicator gadget and include any routines needed to implement
'  it, and make a simple V-TFT project to hold and show it off with and post it
'  for others to download and check out.
'  (please include enough instructions or comments for others, to keep it at
'  least easy to use in their own projects)
'
'  I invite you to use any part of the user code or methods I demonstrated in your
'  own projects and if you do put your project up for downloading by others to
'  have as your example, please have comments by my code you used stating that
'  you got it from this example, so others can trace back to get original material
'  for use if they want it.
'  Thank you for any passing and sharing of methods, ideas, solutions, examples
'  you have or may do with the community.
'==========================================
'//////////////////////////////////////////////////
'==========================================
' User code subroutines and/or function routines
'
'+ COUNTER DISPLAY OBJECTS DRIVER AND DISPLAY UPDATER ROUTINE.
'   Routine takes the value in COUNTER_VALUE variable and converts it to a string
'   of 10 characters and updates the 7 Buttons captions with the 7 right most
'   characters in the temp string after the longword to string with zeros conversion.
'   This was the best way I could think of to get the digits separated out of a
'   single variable holding the count total. One method I actually tried (wrote
'   code for), was to have the routine keep track of each digits displayed value
'   separately and only update the Button(s) that have changed values.
'   Even though it worked, I realized it was too complicated for what needed to
'   be done and while this routines solution redraws all 7 Buttons whether the
'   value for a Button has changed or not, it is much simpler, uses a lot less
'   variables (always a good thing), and executes much faster due to less code
'   and almost no conditional testing required. I have to give thanks to ***aCkO***
'   (*Aleksandar*), for a bunch of help information about the proper way(s) to do
'   string elements manipulations without causing memory corruption.
'   Without his advise and intimate knowledge of these compilers, many of us
'   would be struggling and much frustrated. Thank You Again ***Aleksandar***.
'   So as a *bonus*, now you also get a little bit of example code about string
'   element direct manipulations that the compilers manuals *do not* provide correctly*.
'  *(the mBASIC help file does not provide it at this time, go see what I mean)
```

```
sub procedure Event_Counter()
' create local temp variables
dim TEMP_STRING as string[10]   ' temp string for LongWord conversion result holder
    SHRT_STR    as string[1]    ' temp string for holding a single character

' test to make sure value is valid (0 <= COUNTER_VALUE <= 9,999,999)
if (COUNTER_VALUE > 9999999) then
   COUNTER_VALUE = 0            ' out of range - roll over to zero(s)
end if

' convert the COUNTER_VALUE variable value directly to a 10 character long
' string with leading zeros (to match the counters display methodology)
                                ' Conversions Library Function
LongWordToStrWithZeros(COUNTER_VALUE, TEMP_STRING)

 ' Example: if COUNTER_VALUE has value of 36272, then TEMP_STRING would contain
 ' the characters "0000036272" + null character after conversion.
 ' Then individual access of the strings elements by the code below would result
 ' with:
 ' Button_Million_Caption          = "0"  =  TEMP_STRING[3]   4th element
 ' Button_HundredThousand_Caption  = "0"  =  TEMP_STRING[4]   5th element
 ' Button_TenThousand_Caption      = "3"  =  TEMP_STRING[5]   6th element
 ' Button_Thousand_Caption         = "6"  =  TEMP_STRING[6]   7th element
 ' Button_Hundred_Caption          = "2"  =  TEMP_STRING[7]   8th element
 ' Button_Ten_Caption              = "7"  =  TEMP_STRING[8]   9th element
 ' Button_One_Caption              = "2"  =  TEMP_STRING[9]  10th element
'* Button_One is right most digit displayed,
 ' and Button_Million is left most digit displayed in event counter display.
 '
 ' Now pull out each individual character for place holder digit value displayed
 ' in counter display starting with the Ones value first and redraw each Button
 ' after its Caption property has been updated
 '
 ' first we make sure SHRT_STR has a terminating "Null" character in the 2nd
 ' string element SHRT_STR[1]. The value in the 1st element is considered to be
 ' "unknown" upon its declaration and until it has been assigned a value.
 SHRT_STR[1] = 0               ' or SHRT_STR = "0" would work also. The difference is that
                               ' this example sets a value to both elements of  SHRT_STR, so
                               ' would actually take more machine code to accomplish when it
                               ' was compiled. It does ensure that the value of the 1st
                               ' element is now known also. Keep this in mind when you write
                               ' your own Apps.
 '
' Get Button_One's digit character
 SHRT_STR[0] = TEMP_STRING[9]  ' copy 10th element to 1st element in SHRT_STR
 Button_One_Caption = SHRT_STR ' Ones place holder digit value update
 DrawButton(@Button_One)       ' redraw the button on the screen

' get Button_Ten's digit character
 SHRT_STR[0] = TEMP_STRING[8]  ' copy 9th element to 1st element in SHRT_STR
 Button_Ten_Caption  = SHRT_STR ' Tens place holder digit value update
 DrawButton(@Button_Ten)       ' redraw the button on the screen

' get Button_Hundred's digit character
 SHRT_STR[0] = TEMP_STRING[7]  ' copy 8th element to 1st element in SHRT_STR
 Button_Hundred_Caption = SHRT_STR ' Hundreds place holder digit value update
 DrawButton(@Button_Hundred)   ' redraw the button on the screen

' get Button_Thousand's digit character
 SHRT_STR[0] = TEMP_STRING[6]  ' copy 7th element to 1st element in SHRT_STR
 Button_Thousand_Caption = SHRT_STR ' Thousands place holder digit value update
 DrawButton(@Button_Thousand)  ' redraw the button on the screen

' get Button_TenThousand's digit character
 SHRT_STR[0] = TEMP_STRING[5]  ' copy 6th element to 1st element in SHRT_STR
 Button_TenThousand_Caption = SHRT_STR ' Ten Thousands place holder digit value update
 DrawButton(@Button_TenThousand) ' redraw the button on the screen

' get Button_HundredThousand's digit character
 SHRT_STR[0] = TEMP_STRING[4]  ' copy 5th element to 1st element in SHRT_STR
 Button_HundredThousand_Caption = SHRT_STR ' Hundred Thousands place  update
 DrawButton(@Button_HundredThousand) ' redraw the button on the screen

' get Button_Million's digit character
 SHRT_STR[0] = TEMP_STRING[3]  ' copy 4th element to 1st element in SHRT_STR
 Button_Million_Caption      = SHRT_STR ' millions place holder value update
 DrawButton(@Button_Million)   ' redraw the button on the screen

' And that's it, the Counter display has had all digits updated!
'* If you decide that having every Button redrawn looks bad or unacceptable for
 ' your usage if you use this Display-Gadget in your own project, you can change
 ' each Buttons update to have a test done to see if it actually needs to be
 ' updated. Here is an example way to code to do so:

 '  SHRT_STR[0] = TEMP_STRING[3]
 '  if (Button_Million_Caption <> SHRT_STR) then
 '     Button_Million_Caption = SHRT_STR
 '     DrawButton(@Button_Million)
 '  end if
 '
 '  This would make the display look more natural in operation if you can see any
 '  flickering of the digits that do not change values. Feel free to try both
 '  methods by changing the code for each Button as I shown above on a copy of this
```

dim i as integer

This variable is part of the alternative code of Aleksandar's, it is a Local variable for use below in the For-Next loop.

To use the alternative methods code, comment out all code from here to the "end sub" statement and add these lines above this one.

```
for i = 0 to 6
 SHRT_STR[0] = TEMP_STRING[9 – I]
 strcpy(digits[i]^.Caption, SHRT_STR)
 DrawButton(digits[i])
next i
```

I coded this so it would be a ***clear example*** of manipulating string ***elements*** and not inside optimized indexing code.

These code blocks are good example of a task (operation) that can be done by using a loop to repeat some tasks with different operands indexed by the For-Next Loop structure.

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```
'  project and recompile it and program your device to see what any differences
'  there may be visually. I have not tried this on multiple devices, so I can not
'  state that it will look the same or different when run on different devices.

end sub
'-------------------------------------------------------------------------------
'+++++++++++++++++++++++++++++++++++++++++++++++++
'-------------------------------------------------------------------------------
' the first block of code in this routine handles the repeating calls made to it
' from the loop in main program module. The repeating calls serve a purpose for
' timing of the RESET buttons blinking effect. This is done by changing the
' RESET buttons Transparent property between True (0) and False (1) after every
' BLINK (constant value set in User Declarations above), + 1 times this routine
' is called while the RESET_FLAG variable equals 1.
' The variable BLINK_TIMER is used to keep track of the number of execution passes
' (or calls), this routine gets from the main program loop.
' When the RESET buttons Transparent property is set True (0), another circle that
' is behind the button and colored red to maroon gradient will be visible for
' BLINK + 1 number of execution passes, then the buttons transparent property
' will be set to False (1) for the same number of execution passes and will
' repeat until the user either presses the RESET button again to confirm reset
' or presses the Minus [-] button to cancel the reset counter state. A text
' message of instructions is also displayed while waiting for confirmation or
' cancellation. It gets set visible or not by the RESET buttons event handler
' routine and made not visible also by the Minus buttons event handler routine
' if canceling RESET condition.
sub procedure Reset_Counter()
dim i as integer
  if (RESET_FLAG = 1) then                    ' test if RESET clicked one time
    if (BLINK_TIMER < BLINK) then             '  yes, so do blink timing handling
      inc(BLINK_TIMER)                        ' not enough passes have happened yet
     else                                     '  so add to counter
      BLINK_TIMER = 0                         ' OK, change RESET buttons colors and
      if (CircleButton_RESET_.Transparent = 1) then '    start over counting passes
        CircleButton_RESET_.Transparent = 0   ' Transparent is set TRUE -YES this is TRUE
        DrawCCircle(@Circle2)                 ' redraw red circle
       else                                   ' flip state of transparent property
        CircleButton_RESET_.Transparent = 1   ' Transparent is set FALSE -YES this is FALSE
      end if                                  ' Transparent logic is reversed of others in V-TFT
      DrawCircleButton(@CircleButton_RESET_)  ' redraws RESET button transparent
    end if                                    ' or not.
  end if

' This second block of code when executed will reset the button objects that display
' the individual digits for the value of what COUNTER_VALUE is currently at and clear
' its value to zero and clear the RESET_FLAG to zero and make sure the RESET buttons
' normal colors are visible. It is coded so that it resets ONE digit at a time,
' starting from least to most significant digit (right to left), with a little delay
' between each digit resetting (change all Delay_ms(xxxx) values to suit).
  if (RESET_FLAG = 2) then
    COUNTER_VALUE = 0
    Delay_ms(1000)
    Button_One_Caption          = "0"
    DrawButton(@Button_One)
    Button_Ten_Caption          = "0"
    Delay_ms(100)
    DrawButton(@Button_Ten)
    Button_Hundred_Caption      = "0"
    Delay_ms(100)
    DrawButton(@Button_Hundred)
    Button_Thousand_Caption     = "0"
    Delay_ms(100)
    DrawButton(@Button_Thousand)
    Button_TenThousand_Caption  = "0"
    Delay_ms(100)
    DrawButton(@Button_TenThousand)
    Button_HundredThousand_Caption = "0"
    Delay_ms(100)
    DrawButton(@Button_HundredThousand)
    Button_Million_Caption      = "0"
    Delay_ms(100)
    DrawButton(@Button_Million)
    RESET_FLAG = bFALSE                       ' clear the flag
    BLINK_TIMER = bFALSE                      ' clear the timer
    CircleButton_RESET_.Transparent = 1       ' make sure the buttons real colors show
    Delay_ms(600)
    DrawScreen(Screen1ScreenID)               ' redraw whole screen so RESET message is erased.
  end if                                      ' this approach was used because it is the easiest
                                              ' way to solve the problem of the message text
                                              ' being 'printed' over a gradient background.
                                              ' Normal method to erase text would still leave
                                              ' visible text of a single color standing out
                                              ' from the gradient colors. So redrawing the
                                              ' whole screen with message label visibility
                                              ' set False is the only way to keep screen
                                              ' looking correct.
end sub
'-------------------------------------------------------------------------------
'===============================================================
'-------------------------------------------------------------------------------
'---------------- End of User code ----------------'

' Event Handlers

'
```

Replace with this code:

```
for i = 0 to 6
   strcpy(digits[i]^.Caption, "0")
   DrawButton(digits[i])
   Delay_ms(100)
next i
```

Do Not Modify this comment or put any code above it and below the comment line above!

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From this point on down, V-TFT places Objects Event Handler Routine Code Templates. User must write Task Code.

```
' V-TFT places all screen(s) objects touch, press and click initial blank event
' handling routines below the comment "Event Handlers" above, that it also makes
' in this file (module), whenever the user assigns a new event to a screens object.
'
' All event handler routines are considered "implements" code by compiler.
' All event handler routines are blank when V-TFT creates them and needs the
' user to put their own code inside each for action(s) or task(s) to be performed
' when Touch Panel activity causes the assigned event to trigger a call to the
' handler routine(s).
'
' User code inside of a event handler routine can be programmed to do all actions
' needed for the event or call a routine in User Code area that does tasks that
' are common also to other screen objects event handling needs, so they can call it also.
' Other scenarios can also be implemented in this layout for controls coding,
' it depends on what needs to be done by how a user designs the GUI screens.
' Many, many possibilities can be done with this methodology V-TFT uses, a few
' can not, as it is for now. Changes to V-TFT may come that enable more
' flexibility or void what I have described here.
' But mostly, there are no limits to what can be done, if done right.

' + PLUS (+) Button event handler - adds 1 to COUNTER_VALUE variable
sub procedure ButtonRound_PLUS_OnClick()

  if (COUNTER_VALUE < 9999999) then
    inc(COUNTER_VALUE)          ' still less than max so add ONE to counter value
  else
    COUNTER_VALUE = 0           ' at max, roll counter over to zero
  end if
  Event_Counter()               ' call routine to handle updating counter value displayed

end sub
' - PLUS (+) Button event handler - adds 1 to COUNTER_VALUE variable

'-------------------------------------------------------------------------------

'+ MINUS (-) Button event handler - subtracts 1 from COUNTER_VALUE variable
'   and/or clears the "Reset Counter to zero" waiting for confirmation click condition

sub procedure ButtonRound_MINUS_OnClick()

  if (RESET_FLAG = 1) then      ' test if in the waiting for another RESET button confirmation click condition?
    RESET_FLAG = bFALSE         ' yes - so clear the waiting for another RESET button confirmation click condition
    Label_MSG.Visible = bFALSE  ' set stuff back to normal
    BLINK_TIMER = 0
    CircleButton_RESET_.Transparent = 1
    DrawScreen(Screen1ScreenID) ' and redraw the screen to make sure there are no pixel artifacts left over.
  Else
    if (COUNTER_VALUE > 0) then ' not in RESET waiting condition so test if subtract ONE from value possible
      dec(COUNTER_VALUE)        ' value still above 0, so subtract ONE from value
    else
      COUNTER_VALUE = 9999999   ' was at zero, so roll over to max value
    end if
    Event_Counter()             ' call routine to handle updating counter value displayed
  end if

end sub
'- MINUS (-) Button event handler - subtracts 1 from COUNTER_VALUE variable
'-------------------------------------------------------------------------------
'+ RESET Button event handler - Resets COUNTER_VALUE to zero (0) when clicked twice
'
' This object event handler routine does not actually do the tasks of resetting
' the COUNTER_VALUE to zero or changing the counts displayed on the screen.
' What it does do is handle the state of a FLAG called RESET_FLAG that another
' user routine "Reset_Counter()" will use to determine what actions to take.
' The way I have coded this routine and the Reset_Counter() routine is an example
' of how to add confirmation safety to a Button in V-TFT in your projects too.
' The first press of this Button causes Reset_Counter() routine to be called every
' time the main program loop does another execution pass and while the Flag value
' is at One (1), the Reset_Counter() routine just blinks the colors on the RESET
' Button between normal and reddish colors. Pressing (clicking) the RESET Button
' again is required to cause the Reset_Counter() routine to actually clear the
' counters display and count total back to zero.
'
sub procedure CircleButton_RESET_OnClick()
  if (RESET_FLAG = 0) then
    RESET_FLAG = 1              ' set flag to first stage of reset handling
    Label_MSG.Visible = 1       ' RESET_FLAG = 0: Flag is cleared
    DrawLabel(@Label_MSG)
  else                          ' RESET_FLAG = 1: Flag state is RESET button has been clicked once
    if (RESET_FLAG = 1) then    ' RESET_FLAG = 2: Flag state is RESET button has been clicked twice
      RESET_FLAG = 2            ' routine call in 'main' program module loop will call Reset_Counter() routine
      Label_MSG.Visible = 0     ' while RESET_FLAG > 0 value (cleared), and handle blinking the buttons colors
      CircleButton_RESET_.Transparent = 1
      BLINK_TIMER = 0
    end if                      ' while waiting for another click of the RESET button and when (if) it happens,
  end if                        ' it will clear COUNTER_VALUE variable and set all counter digits to 0 (zero).
end sub
'- RESET Button event handler - Resets COUNTER_VALUE to zero (0) when clicked twice

'-------------------------------------------------------------------------------
```

V-TFT Generated subroutine template for the Object: ButtonRound_PLUS_ event action OnClick

Remember: Users have to supply the task code inside of the Template event handling routine(s)!

Comment lines that start with a minus (-) are my end of Routine markers.

Comment lines that start with a plus (+) are my Start of Routine markers.

This Object event handling routine is dual purpose, 1st it checks if a RESET confirmation is in effect and cancels it if it is, 2nd it subtracts 1 from the counter if not canceling the RESET test.

The last Object Event Handler Routine this project has. Only three (3) Buttons to code for. Only tutorial Comments are after here to end of file.

```
'--------------------------------------------------------------------------------

'* Final word(s) from the Author about this example project:
'
' For those who wanted or expected more features or controls or examples of using different
' sources for trigger events to select, I have to say 'Sorry, but as you can see,
' it took me far longer to type the comments and tutorial info than the actual program
' coding for just what is included in this example project for making custom gadgets,
' and it is intended to only tutor and show some important BASIC facts of what makes
' a working V-TFT project and how V-TFT organizes the project parts it makes from
' a users use of its components. It was meant to be a beginners guide for understanding
' the parts of a V-TFT project and guide source for how to implement a few cool
' tricks or practices. I hoped everyone could gain something from this example
' work, no mater the skill level.
' (but mainly that beginners could use to help make sure their projects start
'  off better and work like they wanted with out hitting any common mistakes that
'  would make a V-TFT project not work at all on first attempts to make one.)
'
' The method I used to time the "Blink" intervals of the RESET Button is only one
' way to do this and not the best way for every circumstance when other HW modules
' controlling needs more processor time to work. This method works for this
' application because there is not other tasks requirements of precise timing.
'
' For you more skilled users, here are some suggestions for what you can add to this
' project to make it more versatile and take it to the next level as a example project.
' (Or make it a complete project and Lab tool you can use)
' If you have the time, skill, ideas and ambition, please contribute on this and
' post your results of additions or changes back on LibStock site.
'
' Some additional controls and features a 'real' event counter could/would have:
' Start/Stop/Hold count controls.
' Threshold settings for Analog ADC sampling trigger/monitor source(s).
' Multiple counters for multiple trigger sources and controls to configure them.
' Controls to select from many digital inputs connected to One or more PORTS as trigger(s).
' Controls to configure timing test conditions to any source. (ex... was Digital
' input change long or short enough or time between event triggers equal to a setting?)
' Digital inputs that trigger Interrupt events to count.
' Device HW timers configurations for trigger events to count.
' And/Or anything else you can imagine would be a good feature to have added.....
'
' Additionally, please do not think that just because I said you have to follow
' some rules, (RULEs#1 & 2 & 3 are excluded) that they are set in stone and
' non-violable and are rules that MikroElectronika has established in V-TFT
' (or V-GLCD for that matter). I put those in here as what I have perceived and
' found to be programming practices that work and do not cause issues in V-TFT
' projects. I, like a lot of new users, did just about everything you could do
' wrong with a V-TFT project at my first attempts to make my own application.
' I do not consider myself to be an expert programmer at all and less so when it
' applies to microcontrollers. I am completely self taught on programming PIC's
' and make a lot of mistakes too, so if you find any in this project tutorial,
' do as I do,..... Blame the teacher.   B^)
'
' So take the guide lines I have pointed out as at least good practices to start
' with for a V-TFT project and please push those boundaries to find out what really
' can be done or not yourself s. You will not find out what works, if you do not
' find out first, what does not work.
'
' Lastly, I hope you have realized that the counter display can be used as just a
' numerical (or alphanumerical), display for about anything you want displayed in
' the manner it does. You can also add or subtract to the number of digits or places
' it can display as needed. You have the freedom to imagine and change it like you want.
'
'
' Post or email comments or questions about this example if you have any, and I will
' do best to respond or answer any questions if I can.
' ~~~~~~ Robert Townsley 2013 U.S.A. (MegaHurts) ~~~~~~ '

' End of Module

end.
----------------------------------------------------------------------------------------
```

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Overview of the Driver Module file.

Welcome to the New coverage of an important part of any **V-TFT** project, the Driver Module File.
The ***Driver Module*** is, as its Name *implies*: The **Force** behind any **V-TFT** (*or* ***V-GLCD***) application it creates, *with your help of course*.

The **Driver Module** is so ***critical*** to a project, it is devoid of any *User Code* areas like what is available in the **Events_Code Module** and **Projects Main** *File*. ***Any*** change to any **object** or its *properties* causes **V-TFT** to ***rewrite*** the **ENTIRE** *Driver file*!

So *anything* you do to the *code* in it has ***a very short life*** if the **project** is *loaded back into* **V-TFT**. This is just a part of how **V-TFT** is designed. The **Driver** *file* has to have *a lot of changes* made, based on ***your*** **screen**(*s*) design(*s*) and use of the **components**.
While there are no designated "***User Code***" *areas*, there *are areas* that **you can place your code into *in* V-TFT** that does end up in this file in *special places* that correspond to the code entry dialog windows in **V-TFTs Project Options *menu*** *dialog*.

They are the *only place* and *way* you can have *your code* in the **Driver** file (*for current version 3.7.0. , This limitation may change later*).

Trying to edit those areas outside of **V-TFT** will get ***erased*** once the project is loaded back into **V-TFT**. So *only* do the editing using **V-TFT**s *code dialogs*. See the **V-TFT** *Help File* for more information and usage instructions on those **Code** *entry Dialogs*. They are *not* the ***focus*** of this **topic**. But that information I gave is required for new users to have so you won't have any surprises or spend time doing something that will not work. I will show you where in the Driver file those blocks of User Custom routine code ends up, but that is where I will end any more discussion about them.

If you want to explore doing changes to the **Driver** file, read the ***forum*** threads about others trying to do so. **Nobody** will say it is *easy*. Most report of not having any successful results, so play in this file ***at your own Risk***. To prevent any code loss if you do, make copies of the code you add or change in the **Driver** *file* in a **separate** *file* from the **projects** *files*. It can be a plain text file or a blank module file. Then you can copy your custom code from it back into the **Driver** *file* if **V-TFT** ***overwrites it***.

The ***focus*** of this section about the **Driver** *file* will be showing you the *areas* that will be *helpful* to you when you write *your own* **projects** code. Since we cannot **safely** ***write*** any code in the **Driver** *file*, that leaves us the option of ***reading it***, *correct*? And where to read is what I will show you in this section of the tutorial. These places in the **Driver** *file* contain *useful* **information** for you that can help you do your coding in the ***User Code*** *areas* of the **main** and **events_code** *files*.

The **Driver** *file* has all of the *routines* needed to make a **component** do its *function*. It also has the *routines* to handle **TP** activity and ***determines*** if activity involves any **objects** and if so calls the **objects** ***event-action*** assigned *handling* **routine** which is **your code** for what **tasks** to do on that ***activity***. It also has the **routines** for *device HW initializations*. Each **component** used in a **project** will have all of the *routines* and *code* ***needed*** to make it work added to the other **objects** ***used*** *routines* and *code* and this becomes the **V-TFT core code**.

A **component** is ***not*** a *feature* of the **TFT** display controllers (*exception is **EVE** controller*). They are **constructs** made using *standard* **TFT Library** *drawing functions* defined by each ones *properties data structures* that the **Driver** *file* **object** *drawing routines* use to create them on the **TFT** screen. (***a side note:*** *Screens in **V-TFT** are just groupings of **objects data** for each screen.*) Knowing where these object data structures are in the **Driver** *file* can help you when you are using **Dynamic Objects** (*Static = False*) and you want to manipulate their properties. When making your own **projects**, knowing the right *object drawing routine* to call for each **object** you used is also **important**.

The **2** following section topics will show you those places in the **Driver** *file* where you can look up information that you can ***copy*** and ***paste*** to your *User code* or find the routine(*s*) name(*s*) you need to use for **drawing** or **redrawing** any of your projects **objects**.

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DRIVER FILE

Object Drawing Routines to Use List.

Whenever you add a component to your project, V-TFT adds the routines needed to draw that object, for whatever state it is in, Static or Dynamic. You can find out what drawing routine(s) are available by looking in the Driver File near the top of the file. It should be the 4th listed group from the top.

1st entry is the modules name.
2nd entry is the project includes of other files to link in project.
3rd entry is the external declarations for the driver module to see the event handler routines for your objects.
4th entry is the forwards declarations for all routines the driver file currently has that need to be visible to the project.
This list is where you will find any and all drawing routines for your objects in your project. This list will change according to objects used and their Static Property setting. See the sample listing below for an example.

```
module dspic33epmmb_v370_event_counter_example_driver

include dspic33epmmb_v370_event_counter_example_objects
include dspic33epmmb_v370_event_counter_example_resources
' External Declarations
sub procedure ButtonRound_MINUS_OnClick() external
sub procedure ButtonRound_PLUS_OnClick() external
sub procedure CircleButton_RESET_OnClick() external
'//////////////////////////
sub procedure DrawScreen(dim aScreenID as word)
sub procedure Process_TP_Press(dim X as word, dim Y as word)
sub procedure Check_TP()
sub procedure Start_TP()
sub procedure DrawButton(dim Abutton as ^Tbutton)
sub procedure DrawCButton(dim Abutton as ^TCButton)
sub procedure DrawRoundButton(dim Around_button as ^Tbutton_Round)
sub procedure DrawCRoundButton(dim Around_button as ^TCButton_Round)
sub procedure DrawCLabel(dim ALabel as ^TCLabel)
sub procedure DrawCCircle(dim ACircle as ^TCCircle)
sub procedure DrawCircleButton(dim ACircle_button as ^TcircleButton)
sub procedure DrawCBox(dim ABox as ^TCBox)
sub procedure DrawCLine(dim Aline as ^TCLine)
```

These draw Button routines are for the same component type, but one is for drawing Dynamic Buttons (top one), and the other is for Static Buttons (bottom). Static routines will have a "C" in its identifier name, for Constant.

Here is a trick I use : I copy all of the forwards from here to the event_code file and make them comments. Then I don't have to keep going to the driver file to see or copy to use in my code (*I **copy** the first part to '(' and fill in the rest. IE.. **DrawButton(**@Button_One) for the 1st time usage and copy the completed code for pasting then on*). You can set an area in the **user code** space for putting in comments, any used often long code chains, and mark the area with active comment or a dummy permissible identifier for that area so you can quickly jump there to get a copy of something you don't want to type in. Only works in a compiler or equivalent code editor.

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DRIVER FILE

Dynamic Objects Properties Declarations.

Since '*Static*' **objects** are ***read only***, there is not much to be said about them, except you should remember that the only **V-TFT** *operations* you can perform on them is to ***draw*** them or ***redraw*** them and assign a **TP *event action***. You can make it seem like a *static* **object** has ***disappeared*** from the screen by ***drawing*** another *static* or *dynamic* **object** over it. Of course a *static* **object** has to be ***layered*** in the *right position* **behind it** to work as you ***cannot*** move a *static* **object** during ***run-time***.

The '***Dynamic***' **objects** are where you will spend the *time* **coding** to make them *do more* than just sit on the screen, never changing. So having ***time saving*** *techniques* or *procedures* to help you get the **work done** is important. ***I hope you find this section helpful for this***.

All *Dynamic* **objects *properties*** are initialized in the **Driver file** routine ***InitializeObjects()***, called from the routine ***Start_TP()*** (***see image 1***), that gets called from the **Main program file** at start up. Every ***property*** of a *dynamic* **object** (*except Static*) that *can be* changed by your code during ***run-time*** is group listed by **object** *name* in the ***InitializeObjects()*** routine. As you will see *or have seen*, ***MikroElectronika's*** programmers did a great job with the code **template** layout **V-TFT** makes (***see image 2***).

image 1

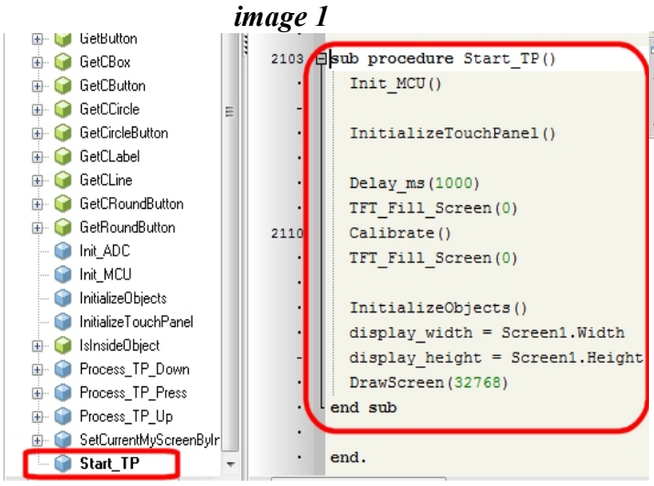
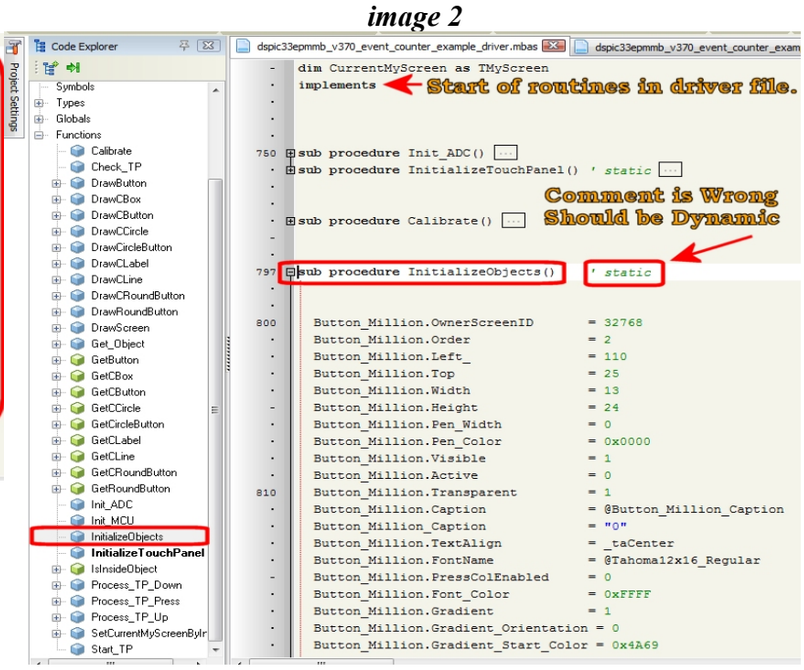


image 2



There is an ***oops*** with the ***comment*** they have **V-TFT** put by the *routines name* though, it should be '***Dynamic***' **not** '***Static***'. (*A Projects **Static** objects **properties** declarations are found **above the** Modules **implements** statement.*)

All of the ***dynamic*** **objects** used in your **project** will have their *properties* listed here. You should ***not change*** the first two (***2***) **objects** *structure* ***values*** though. They are not normal **object** *properties* and are used by the **V-TFT core code *only***. Changing either of them *without* **knowing** what you are doing will *cause* ***problems*** with your **program** *running right*.

The **1st** one is used to indicate the **screen** that the **object** *belongs to*. *(IE. Button_Million.OwnerScreenID = 32768)*

The **2nd** one is the **objects** drawing ***Order*** *priority* for the **DrawScreen()** *routine*(*s*). *(IE. Button_Million.Order = 2)*

The rest of the objects property variables and pointers you can see and, ***Copy*** the ones you are going to use in *your* **projects *User Code*** *routines* to change an **objects** *position*, *size*, *color(s)*, *visibility*, *transparency*, *active* or other *properties* as you need.

Use the same trick of ***Copying*** the **properties** (*variables names or pointers names*) you plan on affecting with code over to the **Events_Code** file and ***Paste*** them as *comments* in the *routines* that will be using them so you can ***Copy*** and ***reuse*** when you need the **property** *variable* in code.
This way you will get the *names* ***correct*** and avoid ***syntax*** and ***declarations*** **errors**.

You can learn a lot by studying the **driver file** too. There are some cool codes and methodologies being used in those **V-TFT core code** *routines*. If you do not know much about **structures**, **pointers**, and complex ***nesting*** of **conditional tests**, if you try to figure out what is going on in this **module**, you can learn a lot by its *example*. But ***it is*** pretty *complex* stuff.

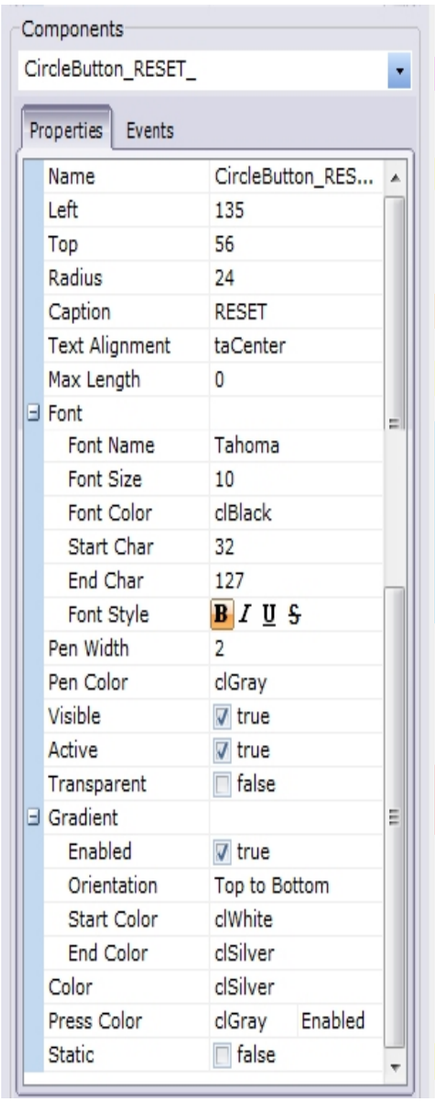
Not all of the *comments* that it does have are *helpful* or in a few places, ***wrong***. Some of the *comments* ***are*** *helpful* though but there is not enough of them. There are a few *routines* I have trouble understanding as to what is being done because it has complex nested logic testing and/or references being done *without* any *comments* to ***illuminate*** its **function**.

When I'm working on a **project**, I check this *routine* ***before*** leaving **V-TFT** to work on it in the **compiler** to make sure the **objects** I wanted to be ***Dynamic*** **are listed** and the **objects** I wanted to be ***Static*** **are not** in the *listing* here (*they should be in the declarations area above the "implements" statement*).

There is no harm in exploring the files in a **V-TFT** project, so look all you want, but remember that editing the **driver file** or the others that *do not have* "***User Code***" areas is not recommended unless you know how to do it without causing problems. There are a few *threads* on the **V-TFT *forum*** about different ways to get around some of the *limits* that **V-TFTs *project structure*** *imposes* and a very good topic by forum member "***aCkO***" on how to ***reuse*** **objects** on different screens instead of the way **V-TFT** has you make a ***Copy of*** or make new ones for each screen.

He has also made a number of utilities for the community in various categories for ***MikroElectronika*** product users, including **V-TFT.** The last thing to show (*maybe it should have been the first*) is a comparison of an **objects** *properties* in **V-TFT** and how it gets put into the **driver file** *code*.

The **image** at *below* ***left*** shows all of the *properties* for the *tutorials* RESET **CircleButton** ***component***. The **CircleButton** ***Component*** *properties* structure **variables** *names* are shown to the ***right*** of its location in the picture of the ***component*** *properties* explorer window.



The Current Object on the Current Screen Selected.

See text below in Yellow section about this property.

CircleButton_RESET_.Left_
CircleButton_RESET_.Top
CircleButton_RESET_.Radius
CircleButton_RESET__Caption ***See text below in Orange section about this property.***
CircleButton_RESET_.TextAlign

See text below in Yellow section about this property.

CircleButton_RESET_.FontName
See text below in Blue section about this property.
CircleButton_RESET_.Font_Color

See text below in Blue section about these properties.

CircleButton_RESET_.Pen_Width ***(in pixels, zero is a valid setting too)***
CircleButton_RESET_.Pen_Color
CircleButton_RESET_.Visible ***(1=True , 0=False)***
CircleButton_RESET_.Active ***(1=True , 0=False)***
CircleButton_RESET_.Transparent ***(0=True , 1=False)***
See text below in Red section about this property.
CircleButton_RESET_.Gradient ***(1=True , 0=False)***
CircleButton_RESET_.Gradient_Orientation
CircleButton_RESET_.Gradient_Start_Color
CircleButton_RESET_.Gradient_End_Color
CircleButton_RESET_.Color ***(1=Enabled , 0=Disabled)***
CircleButton_RESET_.Press_Color CircleButton_RESET_.PressColEnabled

See text below in Yellow section about this property.

And here is the ***complete*** listing of the RESET **CircleButton's** *Properties* that are initialized in the ***InitializeObjects()*** routine**:**

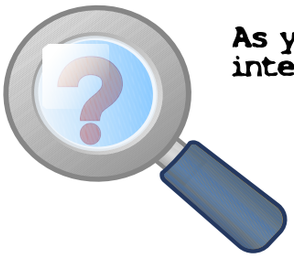
```
CircleButton_RESET_.OwnerScreenID      = 32768
CircleButton_RESET_.Order              = 34
CircleButton_RESET_.Left_              = 135
CircleButton_RESET_.Top                = 56
CircleButton_RESET_.Radius             = 23
CircleButton_RESET_.Pen_Width          = 2
CircleButton_RESET_.Pen_Color          = 0x8410
CircleButton_RESET_.Visible            = 1
CircleButton_RESET_.Active             = 1
CircleButton_RESET_.Transparent        = 1
CircleButton_RESET_.Caption            = @CircleButton_RESET__Caption
CircleButton_RESET__Caption            = "RESET"
CircleButton_RESET_.TextAlign          = _taCenter
CircleButton_RESET_.FontName           = @Tahoma14x16_Bold
CircleButton_RESET_.PressColEnabled    = 1
CircleButton_RESET_.Font_Color         = 0x0000
CircleButton_RESET_.Gradient           = 1
CircleButton_RESET_.Gradient_Orientation = 0
CircleButton_RESET_.Gradient_Start_Color = 0xFFFF
CircleButton_RESET_.Gradient_End_Color = 0xC618
CircleButton_RESET_.Color              = 0xC618
CircleButton_RESET_.Press_Color        = 0x8410
CircleButton_RESET_.OnUpPtr            = 0
CircleButton_RESET_.OnDownPtr          = 0
CircleButton_RESET_.OnClickPtr         = @CircleButton_RESET_OnClick
CircleButton_RESET_.OnPressPtr         = 0
```

Do Not Modify with your code!

See text below in Red section about this property.

See text below about these properties.

1 See text below in Tan section about these Properties.*



As you can see, things are not exactly the same between the code and V-TFT interface. Each has some things the other does not

Don't worry, the reasons why they do not match is not a locked secret with no key to the reasons why there are some differences between the V-TFT IDE interface and the V-TFT generated code that represents the users settings of an Objects properties in the V-TFT IDE.

The following text sections are colored as said above so easier to locate the material that belongs to that properties explanations.

Yellow section:

The **properties** marked above with yellow are settings that are used by **V-TFT *only*** and are not available for users to change with run-time code. The first one is the **Components Name**, so it is used in the name of all of the **properties** also. You ***cannot*** rename (*or re-declare*) a **variable** with run-time code.

The next one is the value **V-TFT** will use to set the **length** of the **Objects Caption String** variable declaration. Again, not one that can be changed anytime during execution of the program. If the **Object** is Static, leave '***Max Length***' at zero (***0***).

The last one is the *all-important* **Object *Static*** setting. It can only be set while in **V-TFT** so the **Objects** *data structure* is coded either as **Constants** or **Variables**. So there is no coded property variable or constant for Static. Its setting is held in the V-TFT projects file.

Orange section:

The **Caption** *properties*, of all **objects** that have a **Caption,** have two *properties* that ***look alike*** but ***are different***. One is a **pointer** to the other one. You can code to use the **pointer** to place new string data into the actual **Caption** *string variable* or you can code to use the **Caption** *string variable* directly. The **V-TFT *Help*** file shows the direct-to-variable as example and ***no mention*** of the **pointer holder**.

You just need to make sure you are using the one you choose to use correctly. This is another good reason to actually ***Copy*** the **property variables** *name* (*identifier*) to make sure *spelling* is **correct** and using the one you intended, because their spellings are so close to the **same**.

Blue section:

The **Font Name** *property* in project code is actually a ***composition*** of **Three** (***3***) **Font** *properties*: (***1***)-**Font Name**, (***2***)-**Font Size** and (***3***)-**Font Style**. Your selections in **V-TFT** on those *properties* gets ***merged together*** into what you will see for the **objects "**`.FontName = `**"** *property*. Compare the settings in the picture (*above*) and the actual **code** listing below it to see how those *properties* ***settings*** were ***merged*** into the **Font Name** *property*. When you want to change any of those **3** *properties* during ***run-time*** with your **code**, you need to only change the **Font Name** *property* and ***the part*** in it you are *changing*.

The **Start Char** (*Character*) and **End Char *Font*** *properties* are **two** more that are **only used by V-TFT** to set what the starting and ending characters of that **Font** set will contain. See the **V-TFT help** *file* for more about this if you need to.

Red section:

This property ***is different*** from the other **objects** *properties* that are of the **two State switch type**. All other **switch type** *properties* use **1** = **True/Enabled** and **0** = **False/Disabled**, but the **Transparent** *Property* of all **Components** is ***Reversed*** of that **Logic** because the **V-TFT** *routines* in the **Driver** *file* ***need it like that*** in order to ***logically*** work **correctly**.

For **ALL Components** that have the **Transparent** *Property* the **Code *Logic*** is: **0** = **True** and **1** = **False*!***
You can see in the picture above that its setting is set at **False** and in the **code** listing below it, that the *property* **"`CircleButton_RESET_.Transparent = 1`" *is*** indeed set at **1** for **False**. The **V-TFT Help** *file* is ***incorrect*** with what it says for this *property*. ***Use this information instead and you will be ok***.

Tan section: 1*

These *properties* are the ones that hold the **pointers** to the **Action-Events** you can **assign** to *most* **Objects**, ***including*** the **Screen** itself. In **V-TFT** you can either ***Double-Click*** on an **Action** to create a *new* **Event Handler** *routine* or choose one from any that have already been made for other **objects**. Every new **Event-Action** *routine* made is ***added*** to the **list** of *routines* that can be *assigned* to an **object**.

Since these **Event** *routine* **pointers** are part of the **objects *dynamic*** *properties*, we **can change** the *assignments* with ***our code*** during **run-time** if we want to***!*** This can be a very *useful* **option** to use for ***certain circumstances***. If you have a very complex **Event Handler** *routine* that has to check for many conditions and do a lot of **tasks** based on the conditions, you might end up having a *routine* that ***exceeds*** the **2000 byte length limitation** any *single routine* may have for *certain* **MCU** *families* ***(see your compiler manual for details on page limits for routines to see if your MCU has this limitation).***

You can ***break*** the *routine* up into *separate* ***smaller*** *routines* and have your code change the **Event-Routine pointer** to point to different *routines* you have made based on ***condition testing***. **Remember**, your **User Code** *routines* and **Event Handler** *routines* are ***both considered*** **"Implements"** in the **project events_code** *module*, so place the **alternative** *routines* in the **"*User Code*"** *area*. **Forward** *declarations* for the other *routines* will also ***need to be made*** at the *top* of the **module** in the *area* **"*User code declarations*"** that I shown is to be used by **Users** for doing this ***(see the topic section in this manual "Project Files "User Code" Template areas" for more information).***

You can use this **trick** for a **lot** of ***reasons***. If you think it will be *easier* to ***change*** the *routine* that ***gets called*** for the **objects TP** *activity* in ***certain circumstances***, **then you can do so**, as long as the **object** is ***Dynamic*** and not ***Static***.

Since this *concept* is ***not covered*** in the **V-TFT Help** *file* and something **I *recently realized*** could be done, there is not any *other documentation* I can point you to that *offers* **more *help*** if you need it. Maybe there will be some *discussions* in the **V-TFT forum** once this *concept* **trick** gets *being used* by some other **users**. I ***might*** add a **code** *example* for doing this in the *future*, but right now I do not have one I can share.

The project I was working on when I made this *realization* and am using it in is not something I can put out for the **public**. The **Example project** this *manual covers* did not need to use it because it is such a **simple program**.

But I decided that it is a **too important** piece of ***information*** to not add it to this manual ***for you to know*** about. ***If*** there are **dangers** or **reasons** to *not use* this **trick** ***(other than the obvious ones)***, ***I*** have not discovered them ***yet***.
(mainly, don't forget when and where you pointed the objects Event-Action Handler to.)

If I do find one that is not an obvious one, I will **post** about it in this **Tutorial projects thread** and add it to this manuals next update version. If you try it and find one, please let us or me know so it can be made known to all users.

That's it for this section. I think that if ***you explore*** the **Driver** *file* and become somewhat familiar with its *design* and *contents*, you could find ***other useful*** **ways** to exploit what it has to make your work on a **project** ***easier***.
I **hope** you found these new sections coverage of the **Driver** *file* ***helpful*** to your working with **Visual-TFT.**

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Additional Community Submitted Tutorial Code Examples, Tips & Tricks & Project Expansions:

If you really want to give thanks, consider this:
I welcome any submissions anyone would like to have me post on libstock of additions or features to this Tutorial example project. It can be as simple as a project conversion to other compilers or device Hardware. I will add it to the Libstock page with your credits. Submissions should have some form of information or description of what and why the differences or the concept it demonstrates if not a conversion to other HW/SW. This document would also get updated to list submissions and include documentation if included.

Forum and active community member Aleksandar (aka aCkO) helped me a bunch on this project and contributed the alternate optimized code for the routines in the "User Code" area. I had intentionally wrote the code very simplified and not using loops to do repeated tasks so readers would easily understand the examples about accessing directly the String variables elements that the mikroBasic help file lacked. That is why I did not just replace my code with his and just showed his as side notes where it would replace my original code.

I thank Aleksandar for his contribution greatly as I did not think to include an example of the normal looping code practice to do the same also, until he submitted his version. I think it made for a very good coverage of using string elements and the object caption property this way. I hope you agree too.

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Additional Credits and Mentions

Aleksandar- For his ***always*** **valuable** help he **provided** and **provides** to the *whole community.* And for working with me to make sure the coding is correct and does not violate **MCU *programming*** *principles*. The **alternative *codes*** in the **program files** are ***his*** examples of using **variable *pointers*** and making use of the ***pointers*** already present in the *structures* of **V-TFT Objects**. His **contributions** to this ***effort*** will help many improve their skill levels, *it certainly has helped mine*.

Marko for all of the personal help, and *correspondences* and ***awesome*** *attitude*. Many thanks for all of his ***hard work*** on the **software** (*more than two or three I'm sure*) **we use** and working with me on ***solving some*** **V-TFT *issues*** and taking my *suggestions* ***to heart***. Always looking forward to working with him again, ***even if it's about a bug***.

Filip and the rest of the ***MikroElectronika staff***. Some of the nicest people on the planet and very thankful they are making more and more development tools that make it *easy* to embed our ***ideas***. One of the best support infrastructures there is and a model for others to follow. *Sure* to have 3**0,000+** forum members in **2014**. **:)** ***(Congratulations by the way!)***

Dany – for his ***many contributions*** and hosting of this tutorial **V-TFT** project at his site also. If you use **PICs**, *check* his site out at http://www.rosseeld.be/DRO/PIC/index.htm He keeps a large '***Vault***' of *goodies* there for **PIC** enthusiasts.

JohnGB for feedback and concept discussions that *fueled* my desire to ***find*** the **Framework** of the **Templates**.

Janni for all the answers he has given to me and many others and the many useful Libraries and *the list goes on*.....

All you guys who **answered *MY*** *questions* I had along the way, many thanks for making the **Forums** what it is.

You users who have given the *courtesy* ***thanks and feedback***, **you're welcome, and a big Thank You**.

To all you *forum* ***members*** that make the *effort to help others*, I ***applaud*** your nature and actions and as a small way to give thanks and honor your legacy, I dedicate this manual to you and make it a **Present** for any who hopefully find it useful.

Merry Christmas from Idaho, USA.

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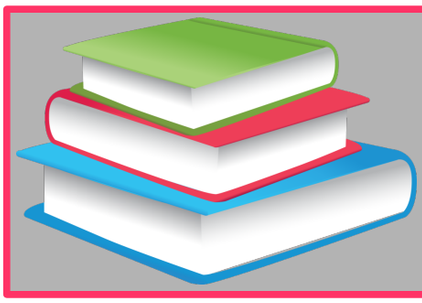

The "***About the Author***" **pdf** is *not* required reading. But if you have a sense of ***humor*** and ***adventure***, you will find *everything* you *(**didn't**)* want to know about ***me*** in the ***stories***, *somewhere*, *maybe*.

I hope you feel you got something valuable from this and it serves you well,
Robert. (**MegaHurts**) ***B^)***

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Answer: ***For the image shown, @ 30 MPH setting – Objects = 12. But the total Objects for it is 34. Not all are ever shown at any time. There are Four (4) different speed ranges the Gauge can be set to : 20 mph, 30 mph, 40 mph and 50 mph. So there are 4 different EVE Number sets, only one showing at a time. There is also 2 EVEGauge Components used to make the speedometer, but only one is showing its tick marks.***