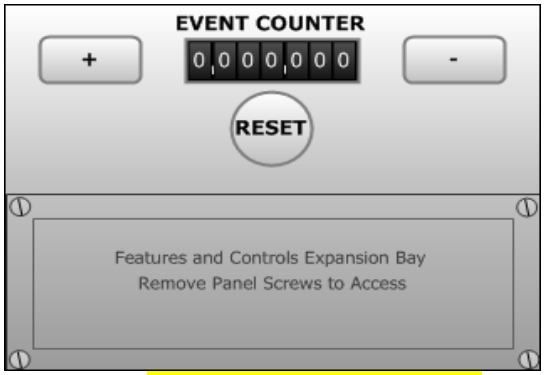
~ MHz Beginners+ Tutorial Projects ~

Visual TFT Files: The User Code program templates

Complete with MikroBASIC Pro for PIC32 and dsP33EP Example Files for a 9,999,999 Event Counter Custom Display Gadget



MANUAL CONTENTS by ORDER: ***Version 2.2.2 11/14/2013***

INTRODUCTION:

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*? ;^)

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.

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

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About Visual TFT for new users:

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**.

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***.

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.

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**.

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.

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 ***What You See Is What You Get*** (***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 .....*).

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 mixtures of each and supporting Pointers. 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.

Note to Advanced Skill level Users reading this manual:

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 challenge at the end of this document.

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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.*

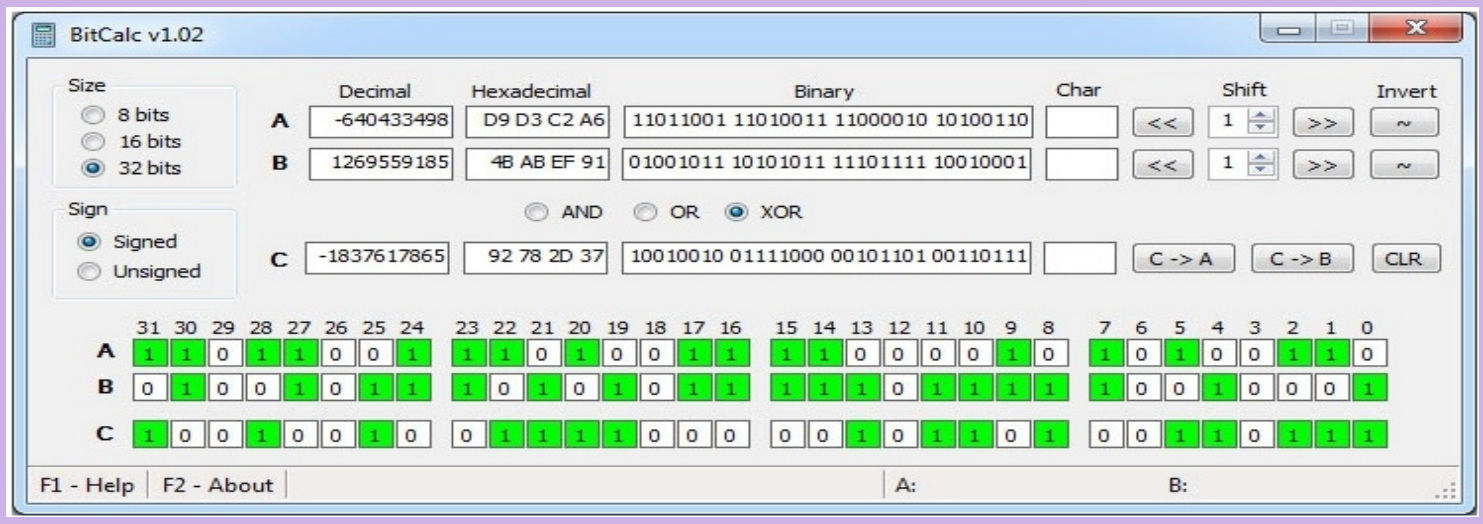
So learning how programmable digital systems actually operate to follow a programs instructions will be one of the best tools you will use when writing your own programs. I did not make the rules, they are a natural result and inherent to all programmable digital devices.

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.

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. Change the names of your **Objects** **before** you assign any events to them. So you should only 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**.

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** on different screens when you are having your code manipulate their properties in large projects. I have developed this naming convention to use that helps me out and maybe it will help you too, or give you ideas on doing your own version:
Every **Object** has the ***screen name*** it *belongs* to as the ***prefix*** to the name – **Screen1Box1**, **Screen1Button1_** ….
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 TFT drawing routine for each Object.

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 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**.

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.

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 before trying to compile and run it on a device.

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.

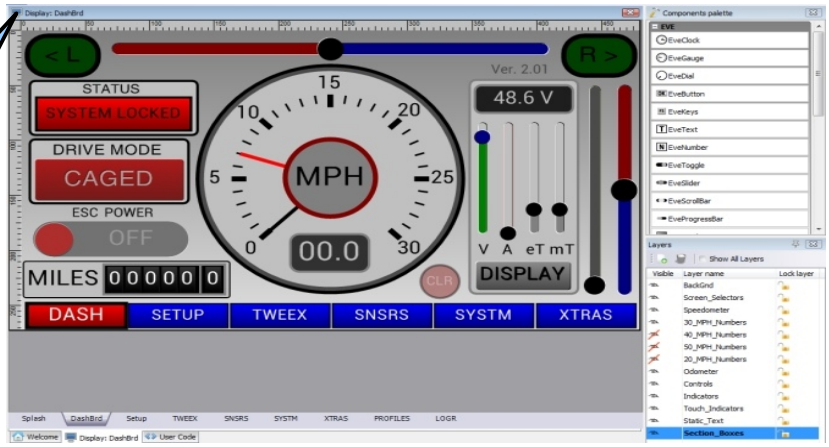
If you use any **Objects** to make a background for the screen, putting them all on a Layer by themselves makes it easier to get the background back underneath all other objects should you need to.
Right-Click the background **Layer** in the "*Layer Window*", select all **Layers Objects**,
Right-Click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

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 the Speedometer gauge? **Answer** is at the end of this manual.



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Components and Layers Tutorial:

About **Components** and **Objects in Visual-TFT.**

> ***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.

> ***This topic is Under Construction More information is being made to fill out the coverage of it.***

Making your own Components:

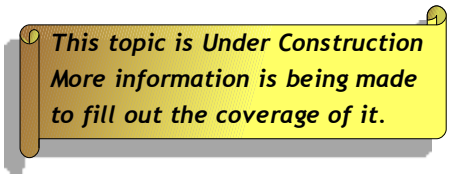
I feel some talk about this is required. There has been requests for some additional components to be added to **V-TFT** and the ability to create custom components that become part of the components palette. While having some new components added to **V-TFT** would be nice, I think users are *not* taking *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**.



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 one possible usage practice 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.

This topic is Under Construction
More information is being made to fill out the coverage of it.

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 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 is lost 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.

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 each used is the big factor of the V-TFT output files sizes.

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.

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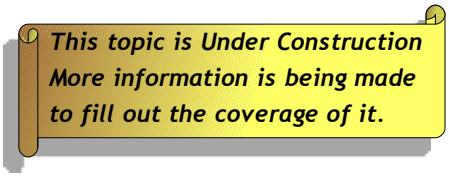
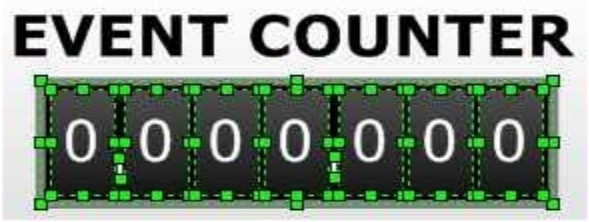
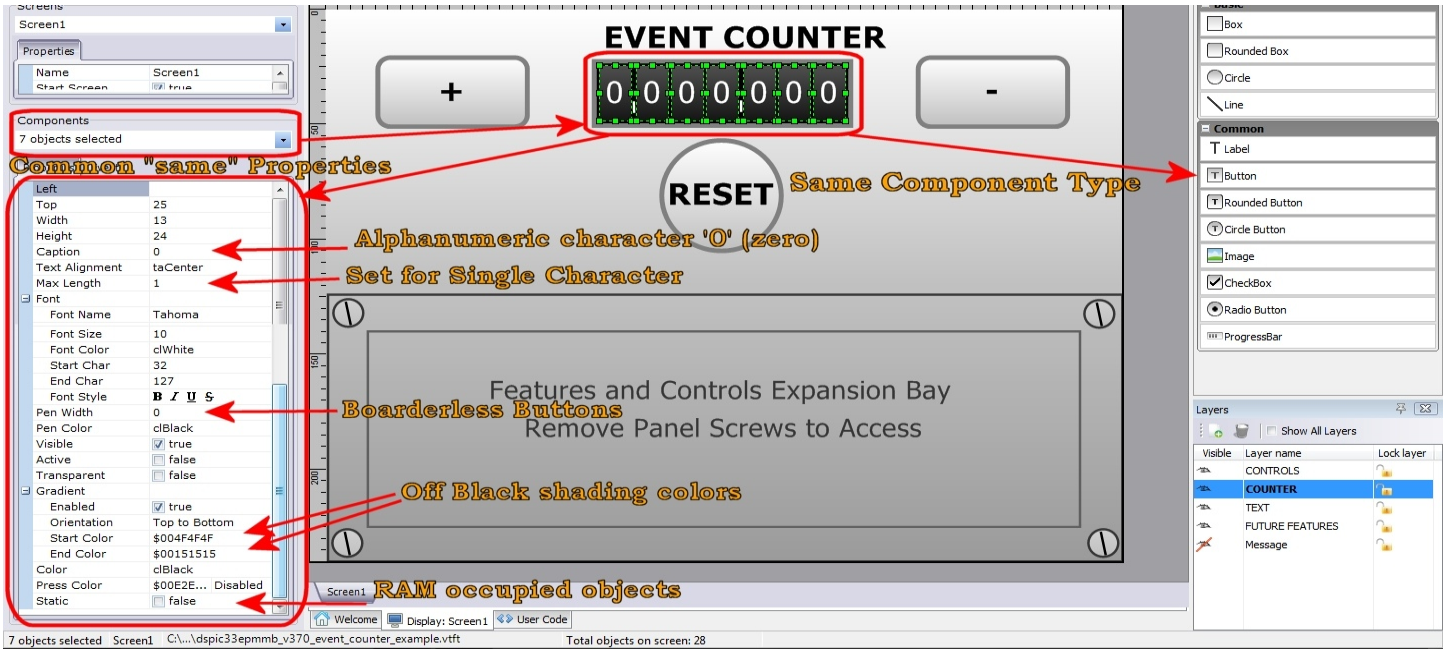


The Objects and Layers used in the Tutorial Example:

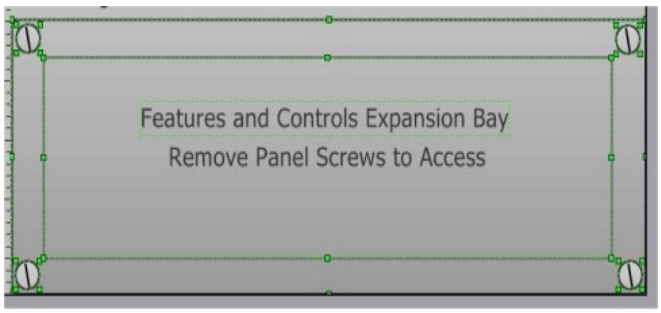
The following screen captures show the objects on a layer all selected so their editing outlines are all visible to you.
The Counter Layer has all of the objects used to make the ***digit wheel display-Gadget***.

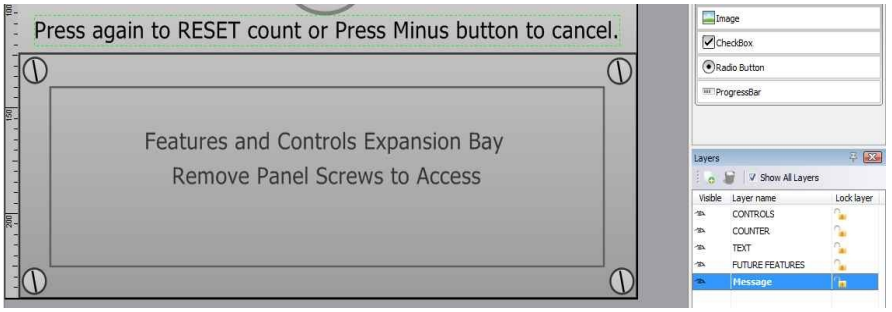


This Gadget is made from **3** different *component types*: **1x Box** , **2x line** and **7x Button** *objects* for a total of **10** ***Objects***.
Each **digit** is displayed by one *Button object*. The picture below shows the **common** "***same value***" *properties* they have.



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.
The Future Features Layer has all of the object used to make the lower half of the screens expansion bay panel.





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***.

For this example, the **Label** "***oldGUILabel2***" is on the *wrong* **Layer – 1**(*Controls*), and we want it on the **Layer – 2**(*Text*). (***see 1 & 2 in the Illustration #1 below***)

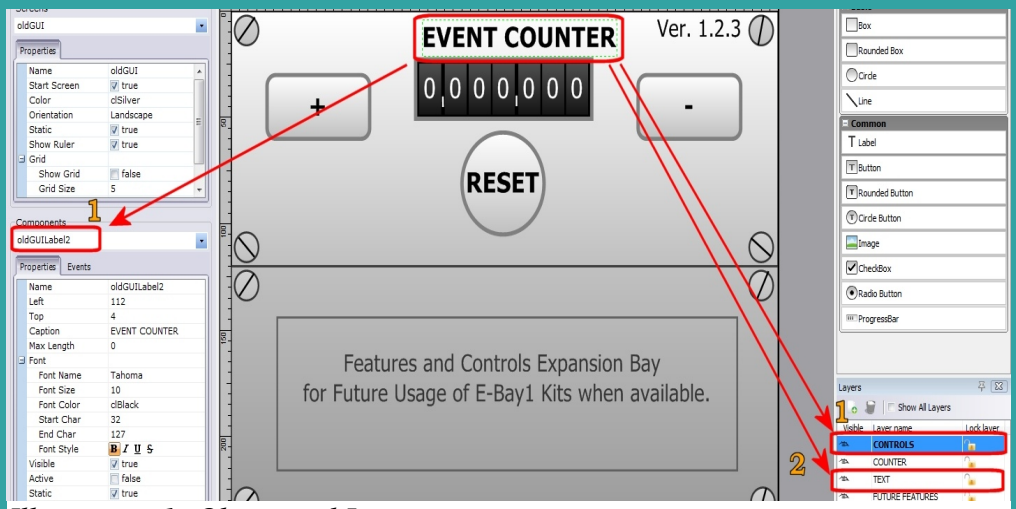

Illustration 1: Object and Layers

(***see Illustration # 2***)
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***).

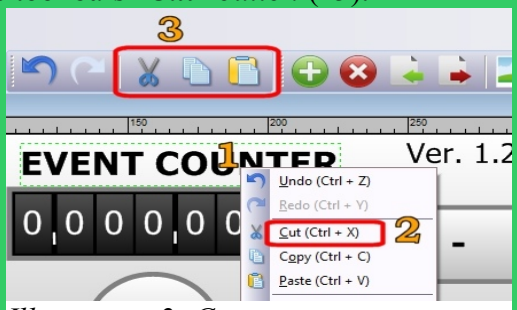

Illustration 2: Cutting options

Illustration 3: Object Cut and available options after.

(***Illustration #3***) 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***).

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 below in ***Illustration #4***.

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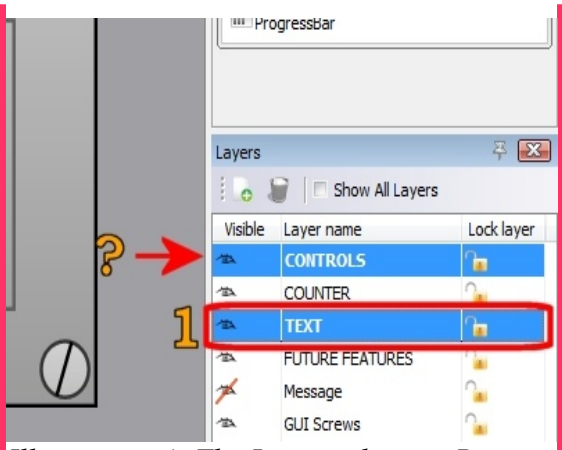


Illustration 4: The Layer selection Bug

If you end up seeing something like the condition shown above (***Illustration #4***), where it appears there is ***two*** **Layers** selected when you ***left-click*** on the **Layer** you wanted to move the **Object** to (***#1 & ?***), you will need to do the following to correct it.

(***Illustration #5***) – First, ***left-click*** back on the original **Layer** (***#1***), so the other **Layer** is no longer also *highlighted* (***#2***).

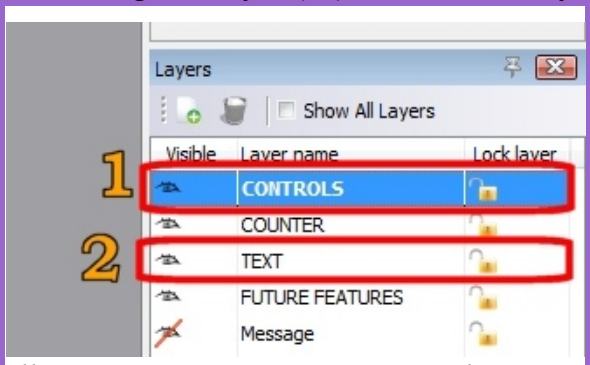


Illustration 5: Correcting Layers selection.

(***Illustration #6***) – Now ***left-click*** the desired **Layer** again (***#1***), and you should see that only ***one*** **Layer** is selected (***#2***).

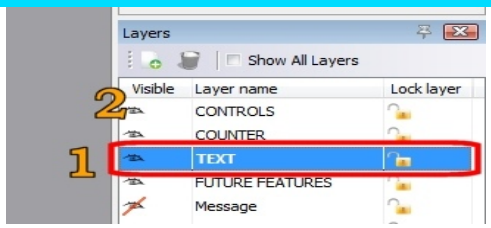
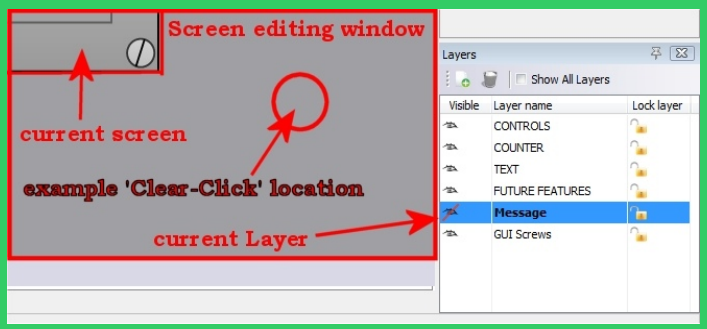


Illustration 6: The Layer desired is now selected

Now ***left-click*** in the screen editing window at a good "***Clear-Click***" location (***#1***), so the **Layer** highlighted name letters go to **Black** color (***#2***) as shown in ***Illustration #7*** below.



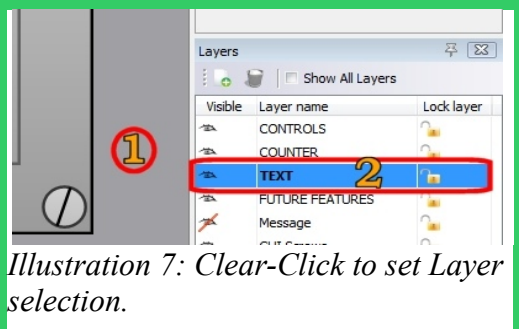


Illustration 7: Clear-Click to set Layer selection.

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 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. So this method ensures you get the results you want.***)

(***Illustration #8***) – Now ***Right-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 below.*

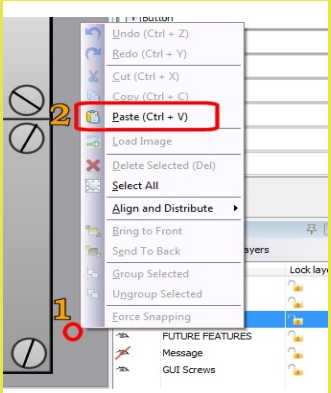


Illustration 8: Pasting the Object to a Layer

Or you can use the **Tool bar *Paste* Button** *also*. (***Illustration #9 - 3***)

(***Or Keyboard [Ctrl]+[V]***)

Illustration 9: Paste

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*** below.

Illustration 10: Object has been moved to new layer.

One of the most often ways an **Object** ends up on the *wrong* **layer** is from trying to ***Right-Click*** and ***Paste*** a ***Cut/Copied*** **Object** when the mouse *pointer* is in the *screen editing area* and *over any* **Object** on the **screen**. It is a ***lot*** *safer* to ***Right-Click*** *outside* of the currently shown screen *and* inside the editing window so there is no **Object** *underneath* the mouse *pointer* to ***effect*** the *outcome* of the *operations*. You can ***Cut/Copy/Paste*** *multiple* **Objects** this way also.

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.

This ends this section of the tutorial for now. But there is still a lot of information left in this manual for you to see and worth your while to do so.

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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.

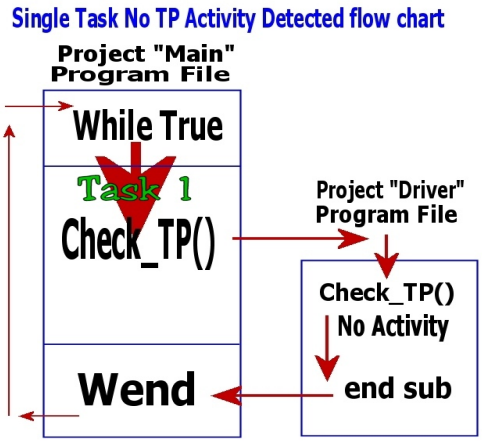

Diagram-1

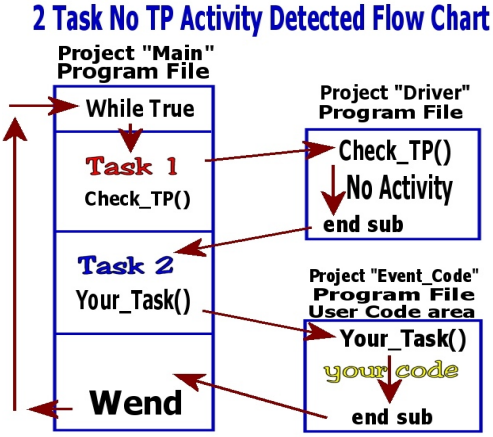

Diagram-2

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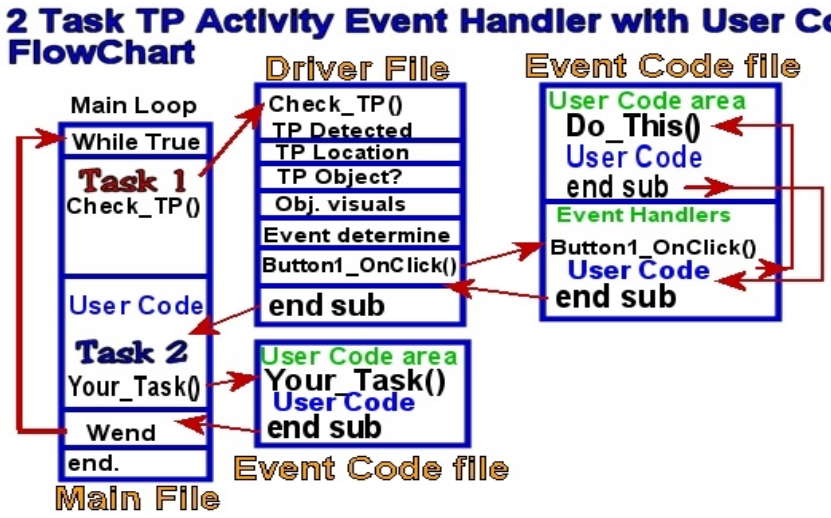
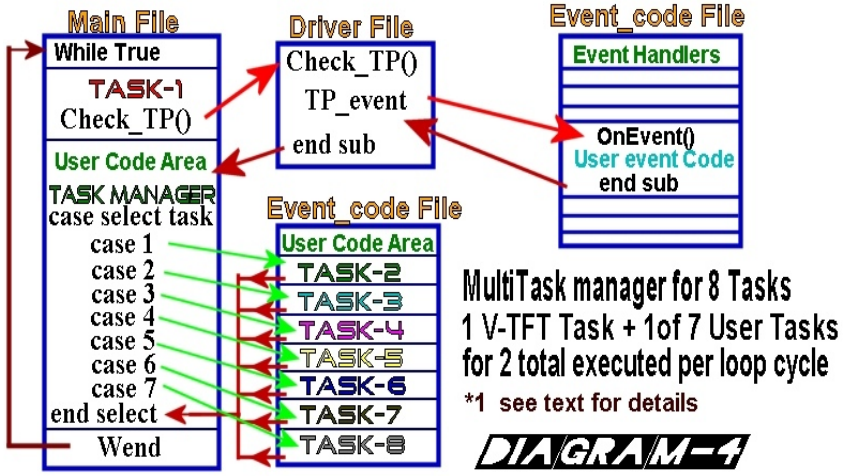


This flowchart shows a simplified example of the main loop pass with Touch Panel usage detected. The user code for the Obj. event handler routine has a task done by another User Code routine also. Depending on the MCU being used, the number of routine calls you can 'stack' on the first one (Check_TP()) 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.

Diagram-3



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". That will be done in a future advanced topics Guide.

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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.

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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
```

Projects module naming

```
include sample_blank_vtft_code_objects
include sample_blank_vtft_code_resources
include sample_blank_vtft_code_driver
```

Linking other modules to this project

```
                OFF LIMITS AREA

'------------------- Externals --------------------'
```

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.

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

OFF LIMITS AREA:

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

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

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'.

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

implements

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

OFF LIMITS AREA:

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

OFF LIMITS AREA

```
' Event Handlers
```

–This starts the area that V-TFT places code templates to declare the process assigned to an objects Event-Action-routine 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 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.

```
end.
```

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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 projects "Main" program file listing as it would look to almost anyone, no mater the language programmed in.

```
' *
' * Project name:
'     sample_blank_vtft_code.vtft
' * Generated by:
'     Visual TFT
' * Date of creation
'     10/30/2013
' * Time of creation
'     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/
' *
```
' V-TFT generated comments about the project and hardware it was
' intended to run on.

```
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"

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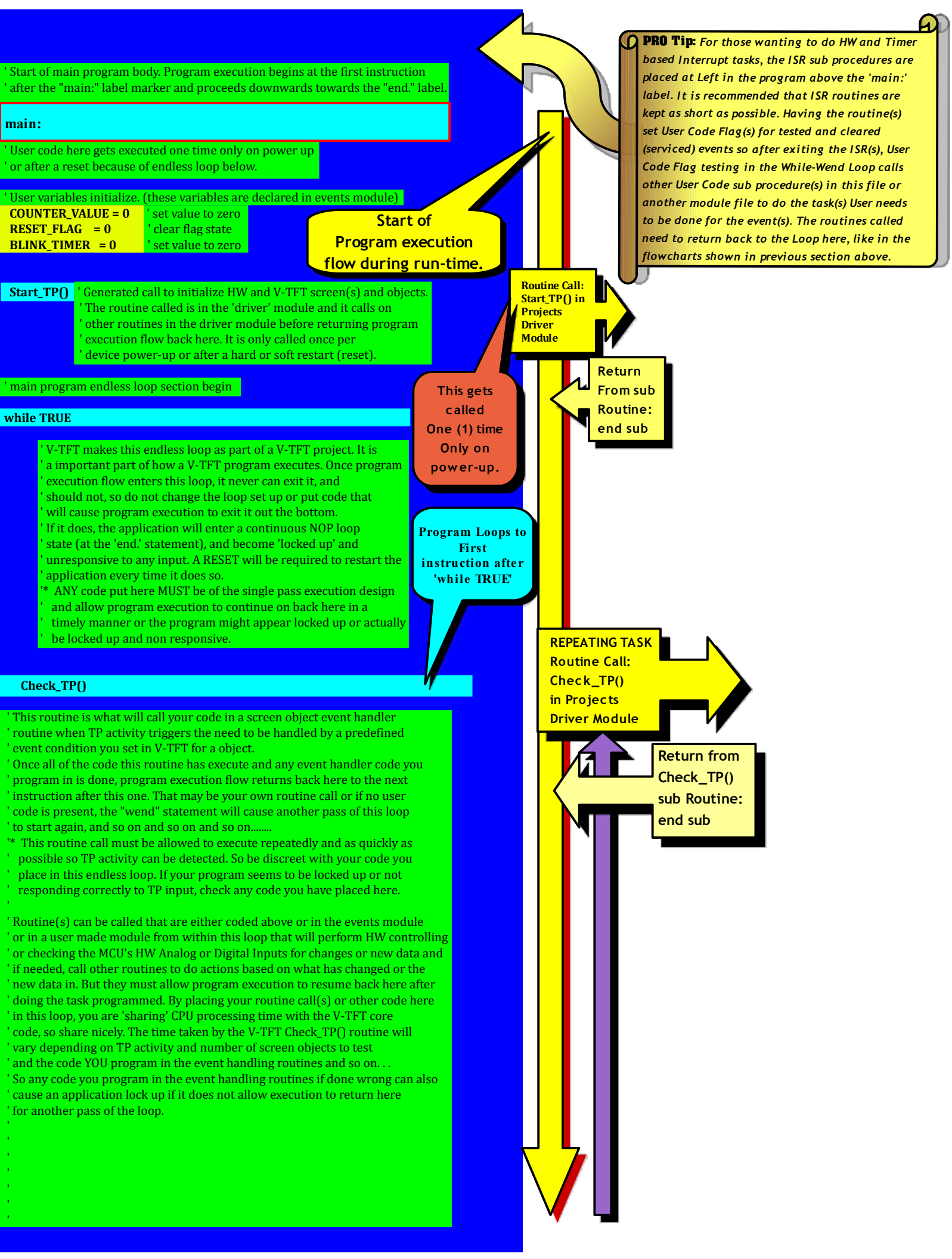
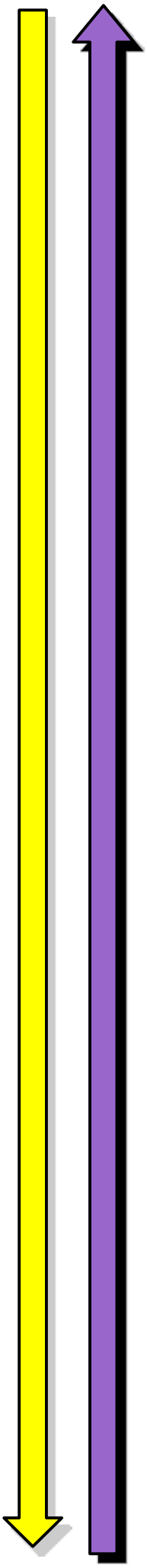
Event Counter Program Main File code Listing

```
' *
' * 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)
'-------------------------------------------------------------------------------
```

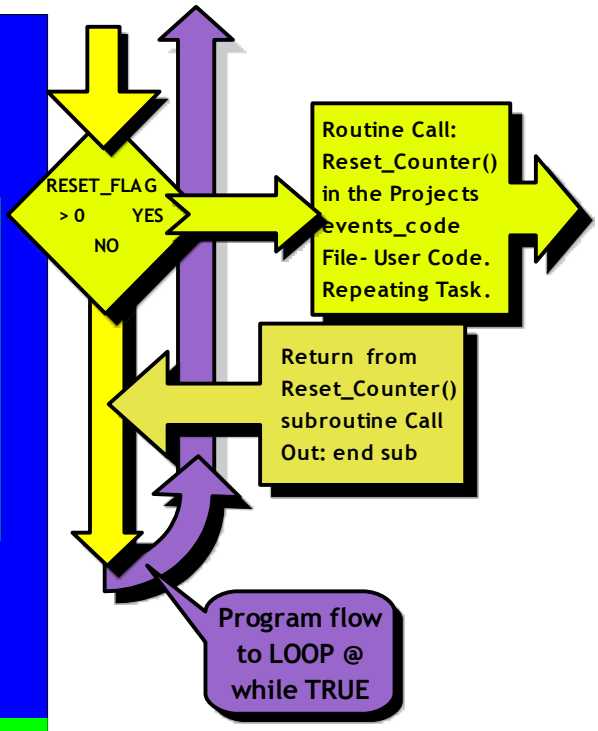

' Start of main program body. Program execution begins at the first instruction
' after the "main:" label marker and proceeds downwards towards the "end." label.
main:
' User code here gets executed one time only on power up
' or after a reset because of endless loop below.
' User variables initialize. (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. A RESET will be required to restart the
' application every time it does so.
'* ANY code put here MUST 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.
Check_TP()
' 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 a 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.
'
'
'
'
'
'
'
PRO Tip: For those wanting to do HW and Timer based Interrupt tasks, the ISR sub procedures are placed at Left in the program above the 'main:' label. It is recommended that ISR routines are kept as short as possible. Having the routine(s) set User Code Flag(s) for tested and cleared (serviced) events so after exiting the ISR(s), User Code Flag testing in the While-Wend Loop calls other User Code sub procedure(s) in this file or another module file to do the task(s) User needs to be done for the event(s). The routines called need to return back to the Loop here, like in the flowcharts shown in previous section above.
Start of Program execution flow during run-time.
Routine Call: Start_TP() in Projects Driver Module
Return From sub Routine: end sub
This gets called One (1) time Only on power-up.
Program Loops to First instruction after 'while TRUE'
REPEATING TASK Routine Call: Check_TP() in Projects Driver Module
Return from Check_TP() sub Routine: end sub

```
'
'
' 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
    RESET_FLAG    as byte

    BLINK_TIMER   as byte
```

```
' variable to hold counted events total
' variable for tracking RESET button clicks
' and Reset_Counter() routine operations
' variable for counting number of passes in
' Reset_Counter as time control for blinking
' colors of RESET button.
```

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.

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```
' 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.
```

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

```
' 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)
'
```

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```
'  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.
'
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.
```

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.

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```
'
' 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
'  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.
```

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
```

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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```
sub procedure Reset_Counter()

 if (RESET_FLAG = 1) then
  if (BLINK_TIMER < BLINK) then
    inc(BLINK_TIMER)
   else
    BLINK_TIMER = 0
    if (CircleButton_RESET_.Transparent = 1) then
     CircleButton_RESET_.Transparent = 0
     DrawCCircle(@Circle2)
     else
     CircleButton_RESET_.Transparent = 1
    end if
    DrawCircleButton(@CircleButton_RESET_)
  end if
 end if
```

dim i as integer

```
' test if RESET clicked one time
'  yes, so do blink timing handling
' not enough passes have happened yet
'  so add to counter
' OK, change RESET buttons colors and
'    start over counting passes
' Transparent is set TRUE -YES this is TRUE
' redraw red circle
' flip state of transparent property
' Transparent is set FALSE -YES this is FALSE
' Transparent logic is reversed of others in V-TFT
' redraws RESET button transparent
' or not.
```

```
' 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)
```

Replace with this code:

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

```
  RESET_FLAG = bFALSE
  BLINK_TIMER = bFALSE
  CircleButton_RESET_.Transparent = 1
  Delay_ms(600)
  DrawScreen(Screen1ScreenID)
 end if
```

```
' clear the flag
' clear the timer
' make sure the buttons real colors show

' redraw whole screen so RESET message is erased.
' 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
```

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

```
' 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.
'
'
'
```

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```
'
' 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.
'
```

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)!

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.

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```
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

'-------------------------------------------------------------------------------
'* 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 more 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.
'
```

This is the event Handling routine for the RESET Button. It's main purpose is to set the RESET_FLAG values when the screen Object has been pressed (Clicked).
The flag controls if another Task in main loop gets executed to actually do the Counter RESET action. See program comments for description of operation.

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```
'
' 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.
----------------------------------------------------------------------------------------
```

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.
I plan to add more detailed coverage to almost every area, there is a lot of stuff I keep remembering (too late) should be included.

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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 and ***Filip*** and the rest of the ***MikroElectronika*** staff.

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**.

All you guys who answered ***MY*** questions I had along the way.

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

I am planing an *Advanced* topics **V-TFT** guide to cover things I didn't in this one. Some of the Topics I want to cover are:

The other **V-TFT** Project files break downs and coverage of ***important*** areas for ***Users***.
Detailed analysis of Components Properties and uses.
Construction of the Components – what makes a component a component.
Advanced usage of user pointers to Objects elements and properties.
Adding User Module files to a Project.
Example of using Interrupts for controlling multitasking.

And if you want something covered, post it, or email it to me @ ***trak_werks@hotmail.com***.

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.

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^)***

Visual TFT Contents