

## Glossary

**IDT Timing Commander Software** – Executable file that will execute a personality, connect to a timing chip on an evaluation board, and read or write Settings files.

**Personality** – Encrypted file with an extension .tcp. Used by IDT Timing Commander Software to determine the characteristics for a specific family of timing devices. A personality file may refer to a single device or an entire family of similar devices. Please contact IDT to obtain the most current version of a personality file for the devices of interest.

**Settings File** – Text file with extension .tcs. Written or read by IDT Timing Commander Software to save or restore a particular setup for a specific version of a device personality and version of IDT Timing Commander Software. Settings files created with newer versions of IDT Timing Commander Software or a device personality may not be compatible when read into older version of IDT Timing Commander Software, or, if an older version of the personality is installed. Forward compatibility (older settings files read by newer software and/or personality) will be maintained.

**Bit Set** – A single variable stored within the registers of the device. A bit set may use only part of a register or many span multiple registers, but is thought of as a single field. For example, a 20-bit output divider ratio may be defined as a single bit set of length 20-bits, but may be stored in Register 0x4A, bits [3:0], Register 0x4B, bits [7:0] and Register 0x4c, bits [7:0].

**Metadata** – Variable used within the personality, but not stored directly in device registers. For example an input frequency is generally not stored anywhere in a device's registers, but must be known to calculate register settings for the device.

**Tooltip** – context-sensitive pop-up that appears briefly as the mouse pointer hovers over an icon or element on the screen. These are intended to provide useful information about the specific item being pointed to.

**Value** – When referring to any field that the user can edit, Value means the current internally-represented value of that field.

**Default Value** – When referring to any field that the user can edit, Default Value means the value recommended by the personality for that field, taking into account the settings in other fields in the device. Changes of other fields may result in a change to the Default Value. Whenever a field is unlocked, Default Value = Value. Only by locking a field can a user set a field to a Value other than the Default Value or prevent a field's Value from changing if Default Value changes.

**Display Value** – A field may be controlled by a personality to display its Value or Default Value in a more meaningful way. For example, if the Value is defined in MHz, but the actual value is 0.008MHz, the personality may choose to display this to the user as 8KHz. In another example, if a bit set represents a divider ratio that can only be an even number and so does not implement the Least Significant bit, the personality may choose to show a divider ratio of 2 when the bit set value is 1 (i.e., 1 increment of divide-by-2).

## Areas of the Screen

A block diagram is displayed when a Settings File is loaded with a personality of a device. There are differential areas in the block diagram as shown and explained below.



**Figure 1. Areas of Screen when a Settings File is Loaded or New Settings File is Selected**

- 1 **Device ID** – This indicates the specific device being selected. Clicking on this will bring up a menu that allows the settings to be viewed and other file related activity (i.e., Save As) to be performed.
- 2 **Error/Warning Panel** – This section will expand and contract depending number of errors and/or warning messages, if any. Clicking on the Warning or Error Tab hide or reveal this section. Note the arrow at the end of each error or warning. Clicking on the arrow will take to the view or popup where the field that flags the error or warning is generated.
- 3 **View Selection** – Clicking on these tabs will bring up the different views of the chip setup.
- 4 **Search** – Any field or diagram element can be highlighted by typing in its name in the Search box.
- 5 **Input Frequency** – the two boxes are where crystal and input clock frequencies are entered, respectively. (Refer to Figures 5~5b).
- 6 **Clock Selection** – Clicking on it will bring up input reference source selection. Checking it activates the clkin as a primary source. Refer to section Input Selection. (Refer to Figures 5~5b).
- 7 **Output Signal Type Control** – Clicking on this box will bring up a popup window in which the signal type, voltage, slew rate and phase skew of this output clock is configured. Refer to Figures 5~7 for details.
- 8 **Output Frequency** – The box is where intended output frequency in MHz is entered. Once a frequency is entered, click outside the box for the value to take effect. IDT Timing Commander Software will use the frequency (together with input frequency) to adjust PLL and output divider to generate the intended output frequency.

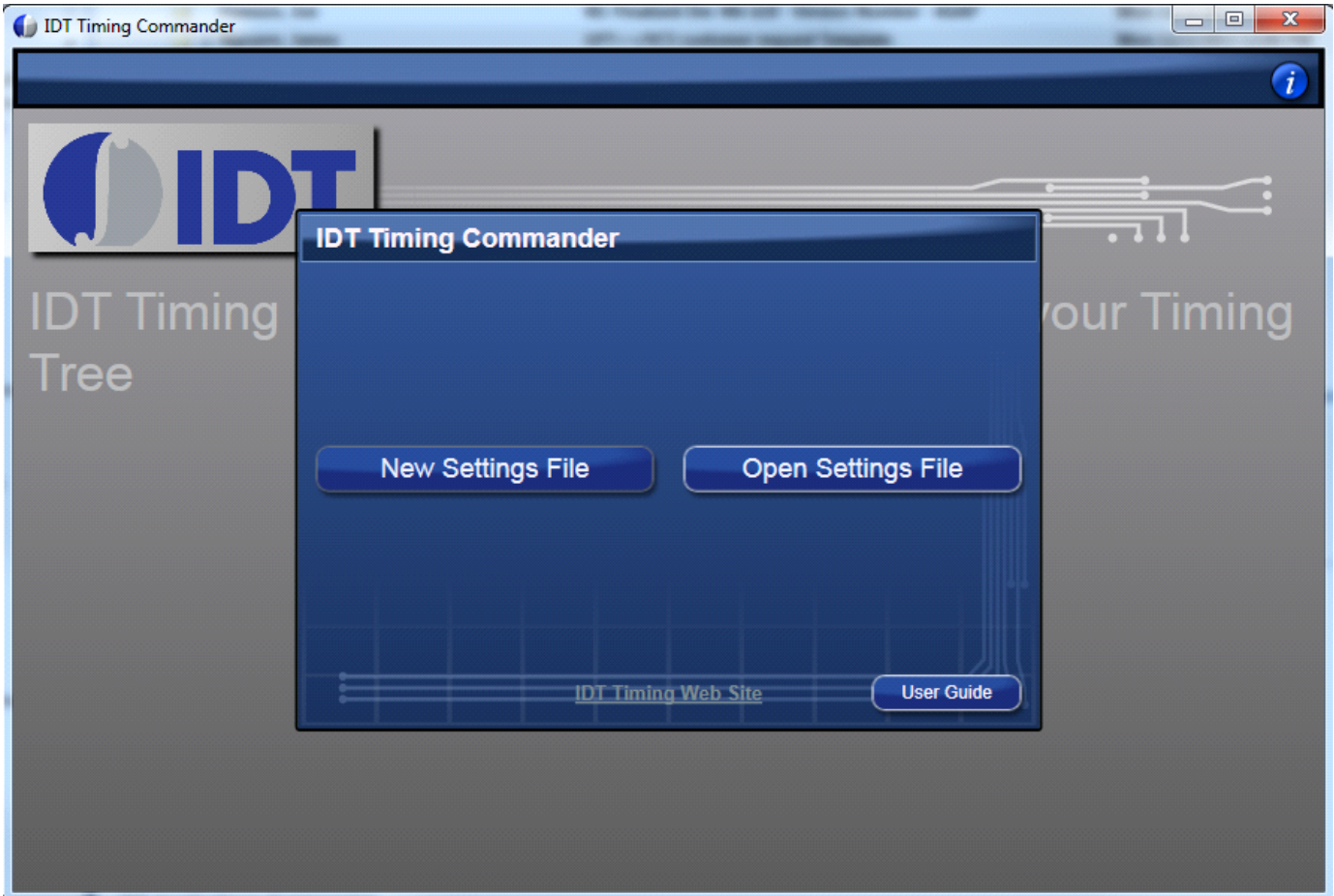
- 9 **Connect to Chip** – If an evaluation board is connected through USB port, clicking on the round button will bring up a window where an I<sup>2</sup>C slave address can be selected; then clicking on the chip symbol to read or write the device's registers. See Figure 10 for details.
- 10 **Zoom** – Clicking on “+” sign will increase the zoom level of the main window. Clicking on “-” sign will zoom out.
- 11 **OTP Program Button** – Clicking on this button will allow you to program the device. Note that OTP programming is one-time only.
- 12 **Shutdown and OE Polarity** – By changing polarity along with the SD/OE pin settings, it affects the OE of the outputs.
- 13 **Enable Global Shutdown** – Puts device in global shutdown mode, if Shutdown and OE polarity is high.
- 14 **ClkSel Pin** – Input clock select, selects the active input reference source in the manual switchover mode.
- 15 **SD/OE Pin** – Enables/disables the outputs (OE) or powers down the chip (SD). The SH bit controls the configuration of the SD/OE pin.
- 16 **Select Configuration Drop Down** – Allows user to select between config [0:4].
- 17 **Fractional Checkbox** – the box is intended to use a fraction value for either the input or the output frequency. (Refer to Figure 5c).
- 18 **Device Pinout** – This button will open up a pinout diagram for the part selected to program.
- 19 **User Guide** – Will open User Guide document.
- 20 **Master Output Control** – This feature will enable the user to enter all output types at once. (Refer to Figure 10a).
- 21 **Show Power Box** – By checking this box, a power consumption estimate will show up under each output. (Refer to Figure 10b).
- 22 **Special Option**– By checking this box, it will bring new buttons in the view (Refer to Figure 10c).

## Getting Started

Follow the steps below to start a new setting or open an existing Settings File and configure the device to meet your timing requirements.

1. **Launching Timing Commander GUI software** for the first time, you will see the following window:

**Figure 2. Launching Timing Commander for the First Time**



A settings file (.tcs) is a text file where the device input and output requirements are stored. From this window, an existing setting file can be opened to restore a configuration, or a new setting file can be started.

2. **Clicking on “New Setting File” button**, a personality file (.tcp) will be requested and can be opened by browsing to the folder where a personality file is stored. Once the personality file is opened (click OK), the following page will be displayed, where the correct Programmable Clock Buffer product can be selected (see Figure 3). As soon as the product is selected, then the configuration window for the selected product will appear like in Figure 4 below.

Figure 3. Choose Correct Programmable Buffer Part Number

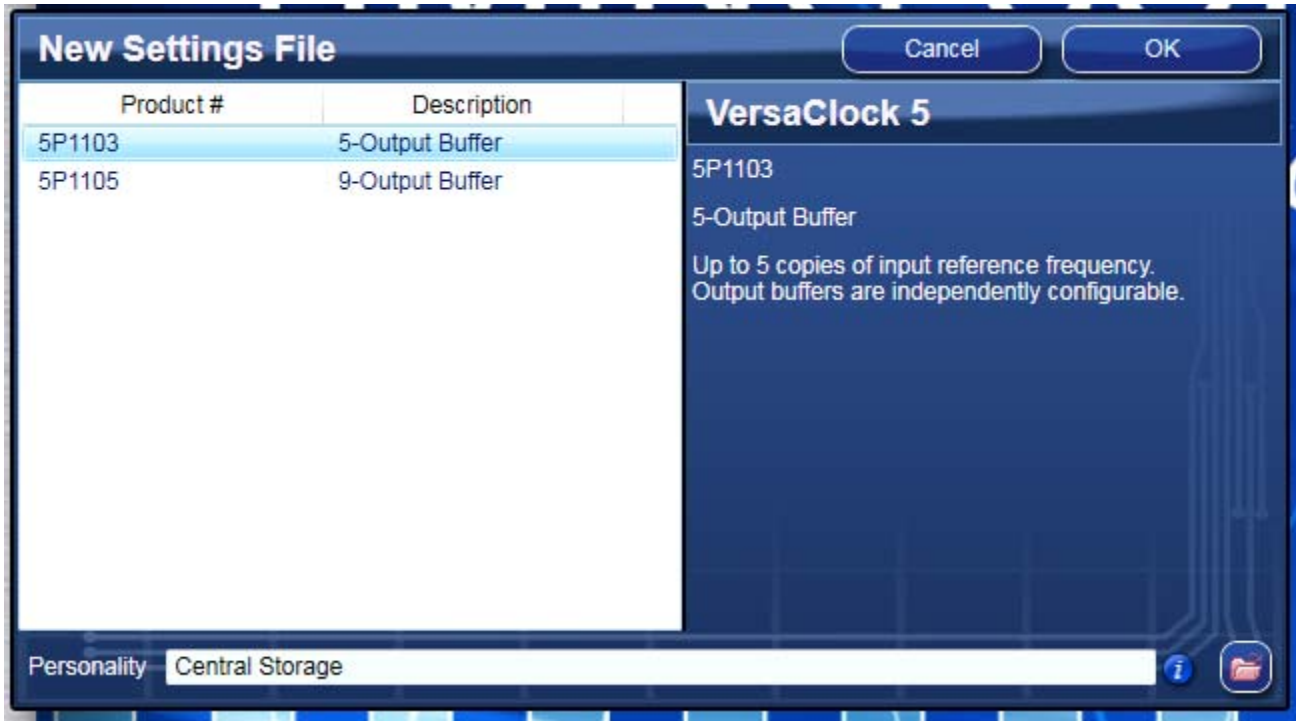


Figure 4. Configuration Window for Configuring 5P1105



In the above configuration window, input source and frequencies can be selected and entered. Output frequencies can be entered. The GUI will automatically configure the PLL to generate desired outputs.

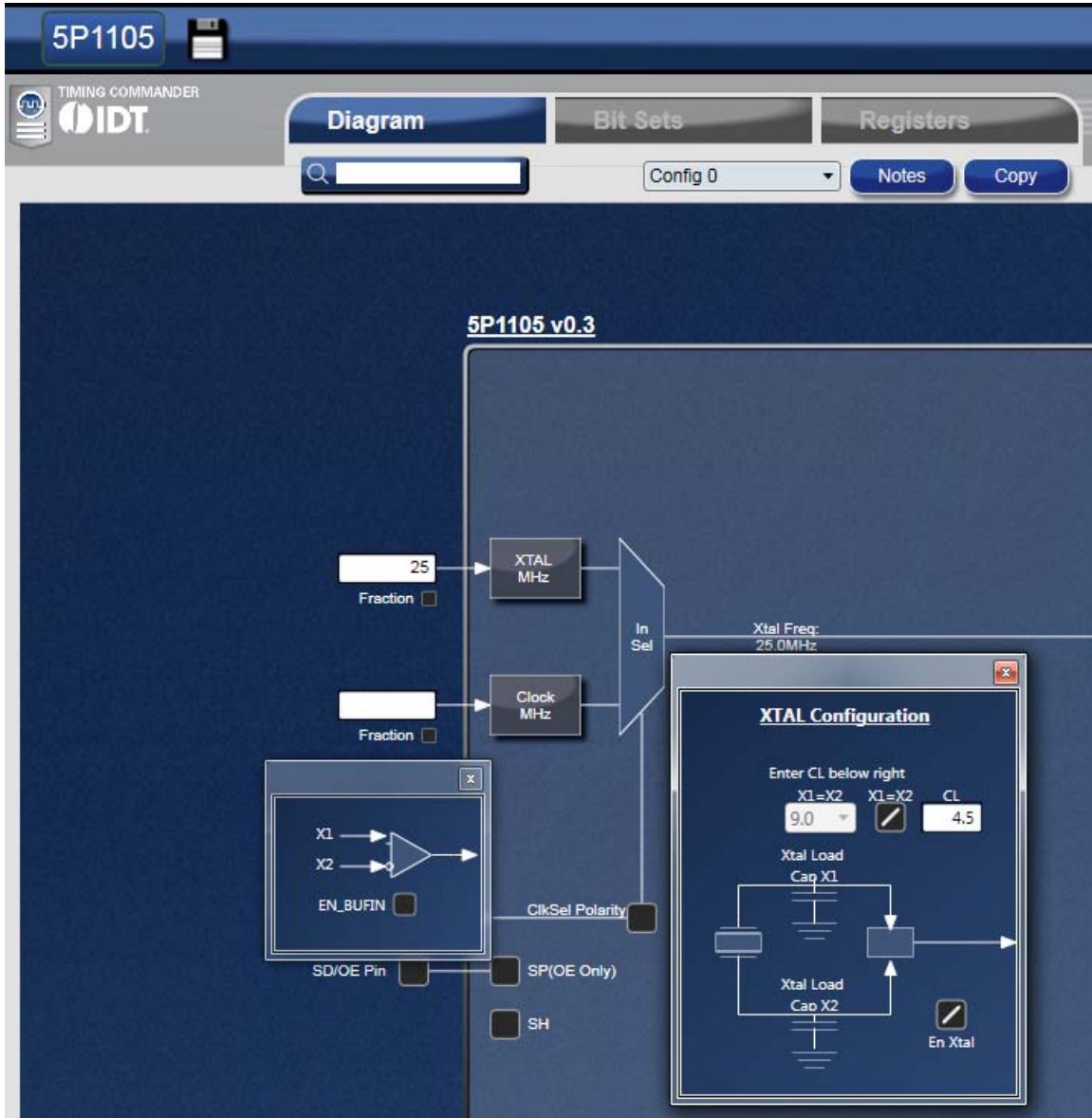


**3. Input selection** – Input source can be selected between a crystal and a clock. The frequency of the crystal or a clock can be entered in the white boxes on the left side of the diagram window.

Selecting an input reference is done by checking the "Prim SRC" bit box along with the setting of the CLK Sel pin. By default, Crystal is selected. Please note, when selecting clock source, it's recommended to open XTAL Configuration and CLK Enable window at the same time by clicking on box "XTAL MHz" and box "Clock MHz", respectively. Figure 5 below shows a side-by-side view of all 3 windows.

When Crystal is selected, "En Xtal" is checked and "EN\_BUFIN" is unchecked. When changing input source from crystal to CLK, manually uncheck "En Xtal" and check "EN\_BUFIN" to complete clock selection process.

**Figure 5. Input Reference Selection**



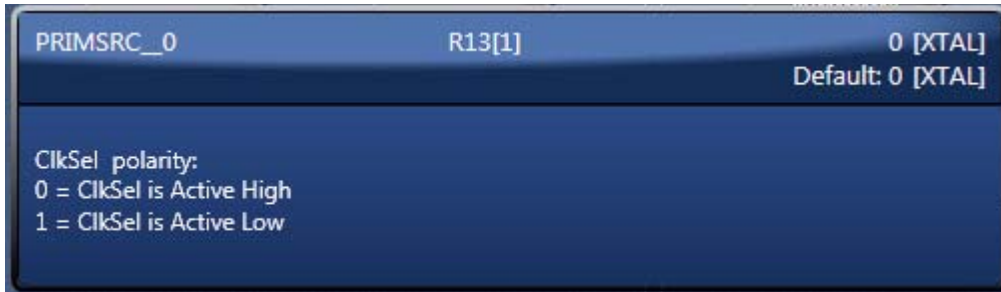
There are situations where both crystal and CLK are used as input sources. In this case, check both "En Xtal" and "EN\_BUFIN". Then use CLKSEL pin to select crystal or CLK source to be used as the input reference. The Truth Table is listed in Table 1 below.

**Table 1. Input Source Selection by CLKSEL Pin**

Primary Source	CLKSEL Pin	Source Selected
Crystal	LOW	Crystal/XIN
	HIGH	CLKIN
CLK	LOW	CLKIN
	HIGH	Crystal/XIN

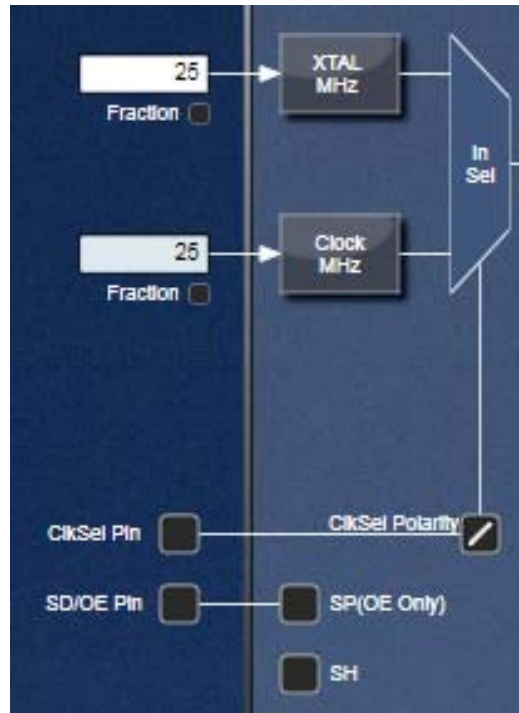
The same frequency should be used for Xtal and CLKin when both are used for the same configuration.

**Figure 5a. Primary Source Selection**



The CLKSel Polarity check box needs to be checked if using the CLK is selected as primary source and if CLK sel pin low like in Figure 5b. The timing commander will display the selected source based on the selection.

**Figure 5b. Input Clock Pin Selection**

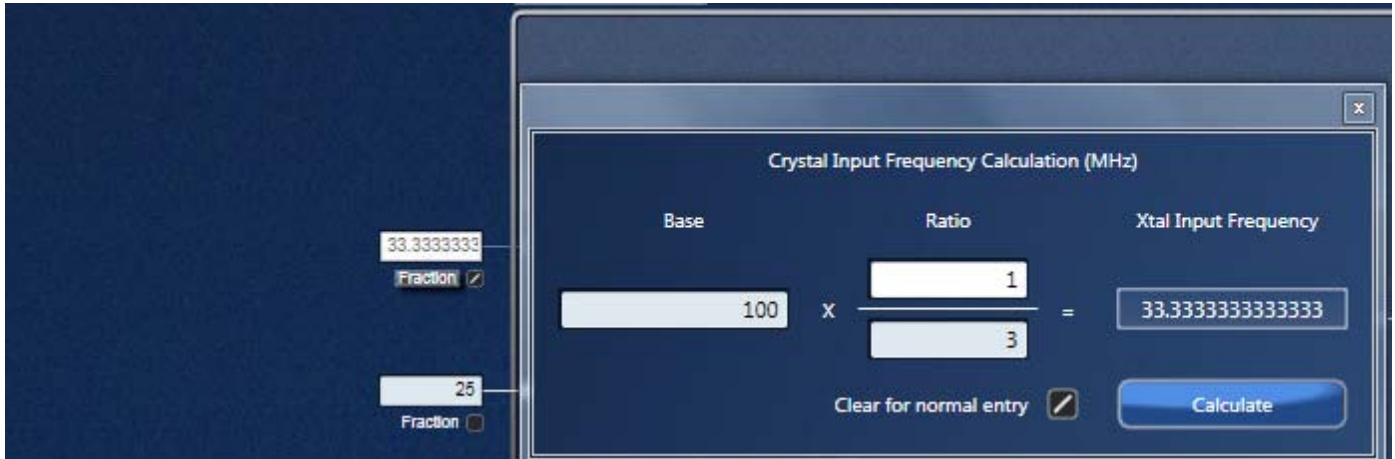


**Input Frequency Fraction box-** Input clock can be entered as a fraction if fraction box is checked and Fraction word is clicked as shown in Figure 5c below.

The calculation button will give the final frequency that will be entered in the input box.

The fraction can be used for both Xtal and CLKin inputs.

Figure 5c. Input Fraction Box



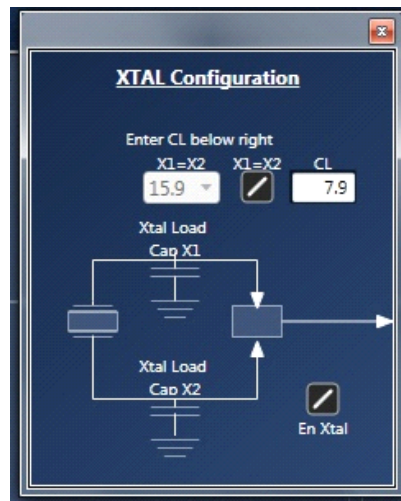
**4. Internal Capacitance Configuration**– The 5P1105/5P1103 has built in capacitance for crystal load capacitance tuning. In XTAL Configuration window (see Figure 6), X1 and X2 represent the capacitance the device can add to each leg of the crystal connected to XIN/REF and XOUT pins.

User can enter the value of the XTAL CL indicated by the Xtal manufacturer. TC will calculate the necessary values for the internal capacitors. The calculation assumes a C stray of 1.5pF for external board capacitance.

The TC will change the enter CL value to the closest realized value that the internal caps can achieve based on real measurements. Example for a XTAL CL of 8pF:

- X1=X2=16pF would be the total value required.
- X1=X2=15.9pF is what consists of 9pF fixed and 6.9pF Xtal load caps.

Figure 6. XTAL CL Value into Timing Commander

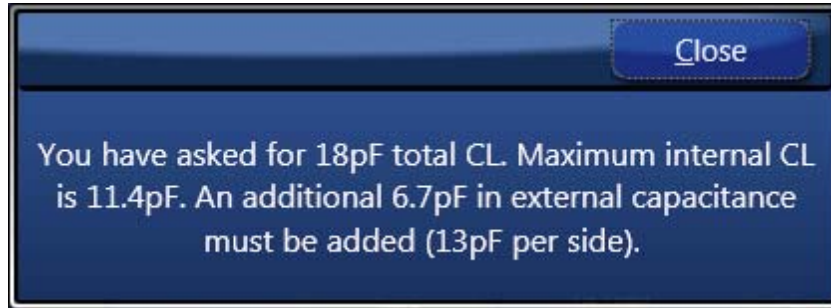


The max CL that can be created in the IC is 11.4pF. When entering a larger value, Timing Commander will display a window advising how much capacitance to add externally to each crystal pin to achieve the desired CL value (see Figure 6a below). TC is rounding the values to a integer value for the advisable external capacitors. Example for a XTAL CL of 18pF:

- X1=X2=36pF would be the total value required
- X1=X2=22.7pF is achieved internally in the device and externally the amount required is 13.3pF (rounded to 13pF)

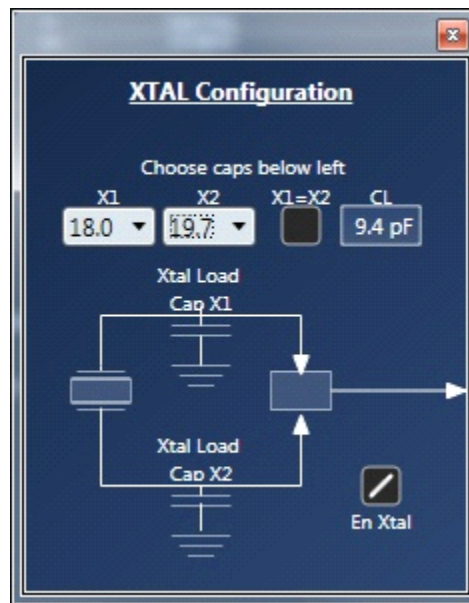


Figure 6a. XTAL Caps Setting Warning Message



The user can still select the caps if the X1=X2 box is not checked. The Xtal CL then will be calculated automatically (Figure 6b.). Different values of X1 and X2 can be individually selected, although in almost all applications, an equal amount of capacitance for X1 and X2 (X1 = X2) is recommended.

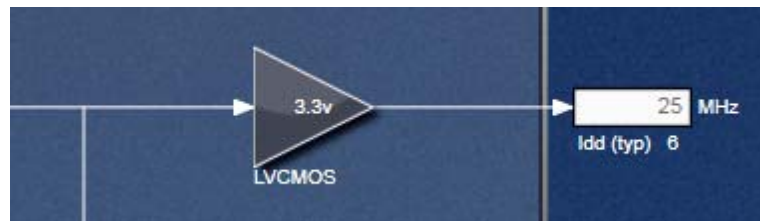
Figure 6b. Independent Xtal Caps Settings



**5. Output Selection and Configuration** – There are 5 outputs in the 5P1105, of which OUT0 is a buffered output of the input source with a single-ended signal format, OUT1~4 can be configured a differential pair, or two individual single-ended outputs with programmable slew relationships.

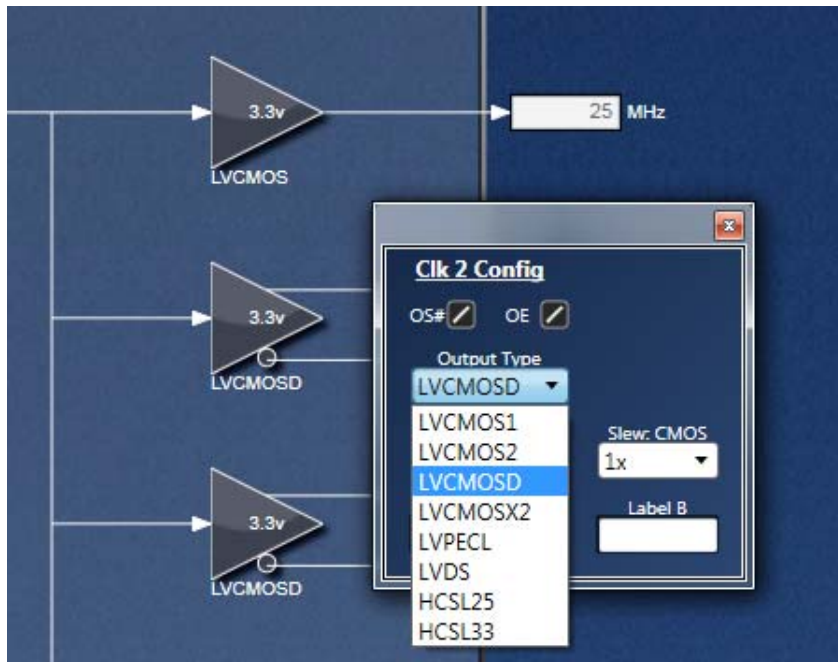
Output1 is displayed below as an example.

Figure 7. Output Configuration (1)



By default, this box is empty if no output frequency is entered in the input frequency box. Once a frequency is entered, it will be automatically display output from input. This box works in the same way for other outputs.

Figure 8. Output Configuration (2)



Clicking on the triangle box brings about output frequency configurations: Output type, Slew rate, Output voltage and Skew.

**Output Signal Type**

- LVC MOS: single-ended low-voltage CMOS
- LVPECL: differential LVPECL
- LVC MOS1: OUT1 is LVC MOS; OUT1B is disabled
- HCSL33: differential HCSL 3.3V
- LVDS: differential LVDS
- LVC MOS2: OUT1 is disabled; OUT1B is LVC MOS
- LVC MOSD: OUT1 and OUT1B are each LVC MOS with 180 degrees out of phase
- HCSL25: differential HCSL 2.5V
- LVC MOSX2: OUT1 and OUT1B are both LVC MOS and in phase

**Slew Rate**

- 1X: This selection corresponds to a slew rate of 1.9V/ns
- 0.9X: This selection corresponds to a slew rate of 1.8V/ns, or 90% of 1X
- 0.85X: This selection corresponds to a slew rate of 1.7V/ns, or 85% of 1X
- 0.8X: This selection corresponds to a slew rate of 1.6V/ns, or 80% of 1X

**Output Voltages**

- 1.8V
- 2.5V
- 3.3V

Selecting an output voltage in settings will configure the drive level of the output. In the PCB board, a matching voltage needs to be used for this particular output.

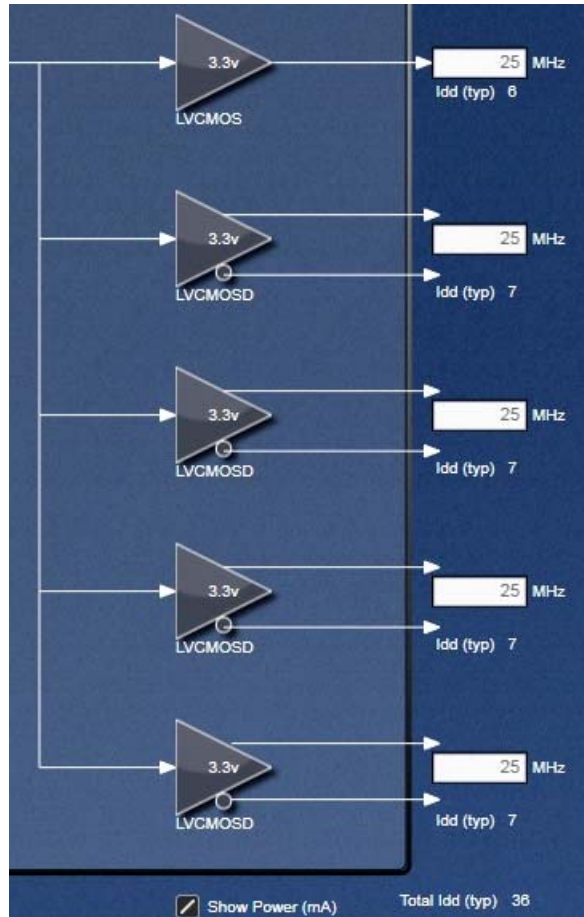
**Output Control window** – This window enable the user to see all the settings of the Master Output Control’s outputs.

Figure 9. Master Output Control Window



**Estimated Power feature** – if checked the box called Show Power will show an estimated power per output type and also a total power consumption in mA (see figure 10 below)

Figure 10. Show Power Estimator Box



**Special Options** – by checking the special option box in the left bottom corner the 4 following buttons will appear in the right top corner: BP string, Current regs to Clipboard, Restore defaults, Change Device Address.

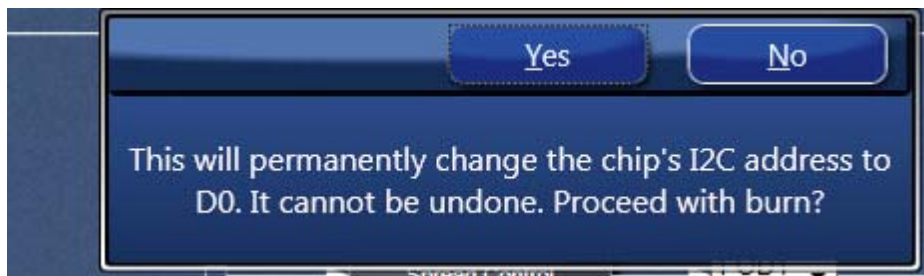
**Figure 10a. Special Options**



When connected to the device it is possible to change the I<sup>2</sup>C address by clicking on the **Change Device Address** button. This is permanent change that cannot be reversed.

A message appears asking the user to confirm if I<sup>2</sup>C address needs to be changed as shown in Figure 10b below.

**Figure 10b. Device Address Change Message**



**Restore default** button – enable to restore the default values into the device.

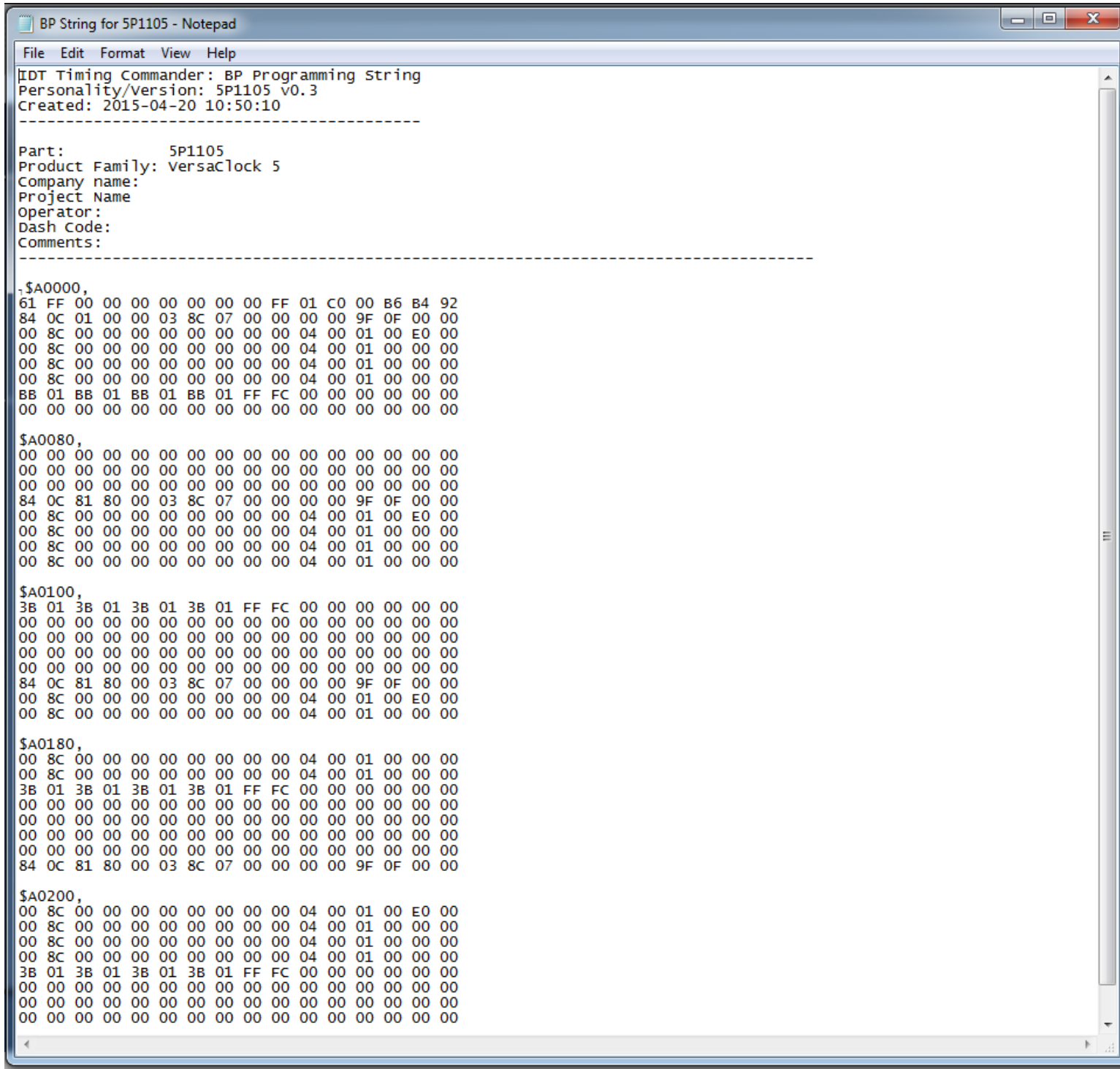
The Current Regs to clip board button copies all the current registers values from one configuration to the clipboard to be copied somewhere else. A message will pop up to confirm that the specific configuration register has been copied to the clipboard. It consists of one line of string containing each register value in hexadecimal.

See example below from register x00 to register x69:

```
61 FF 00 00 00 00 00 00 00 FF 01 C0 00 B6 B4 92 40 0C 81 82 00 03 8C 06 40 00 00 00 9F FF E0 80 00 81 02 00 00 00 00
00 00 00 04 00 00 00 C0 00 00 81 01 00 00 00 00 00 00 00 04 00 00 00 60 00 00 81 00 00 00 00 00 00 00 00 04 00 00 00
A0 00 00 81 00 00 00 00 00 00 00 00 04 00 00 01 90 00 5B 01 1B 01 7B 01 3B 01 FF FC
```

The BP string button will show a formatted string (as shown in Figure 10c) that matches the BP programmer requirements to program a device with the bits reflecting the selection made by the user for the 4 configurations.

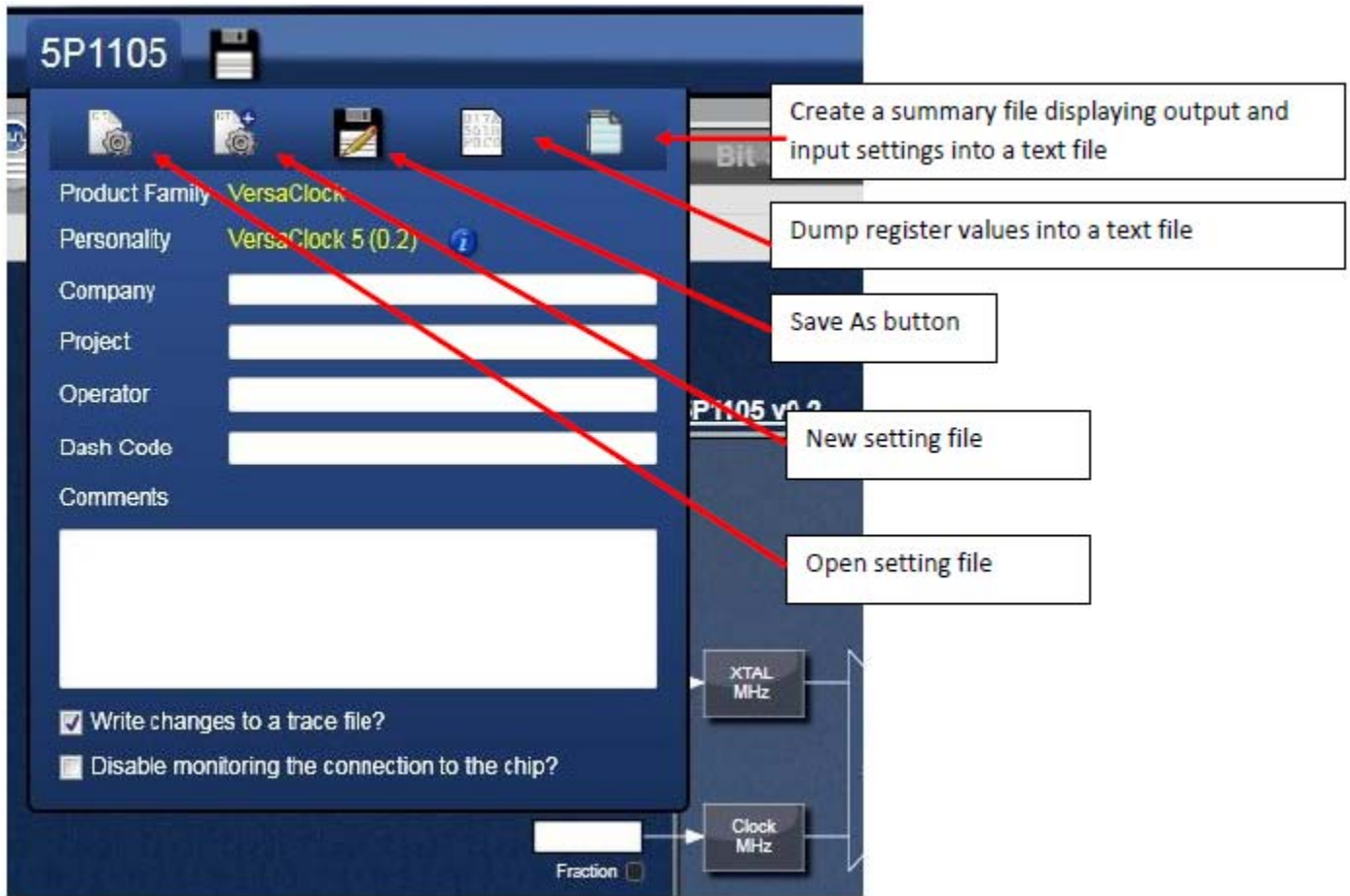
**Figure 10c. BP Micro Programmer String**



**6. Enter Project Details** – By clicking on the programmable buffer part number a window will pop up where many things can be done like open settings file, new settings file, save as, and also enter project details. These should be filled out for proper documentation.



Figure 11. Project Details Information and File Tools



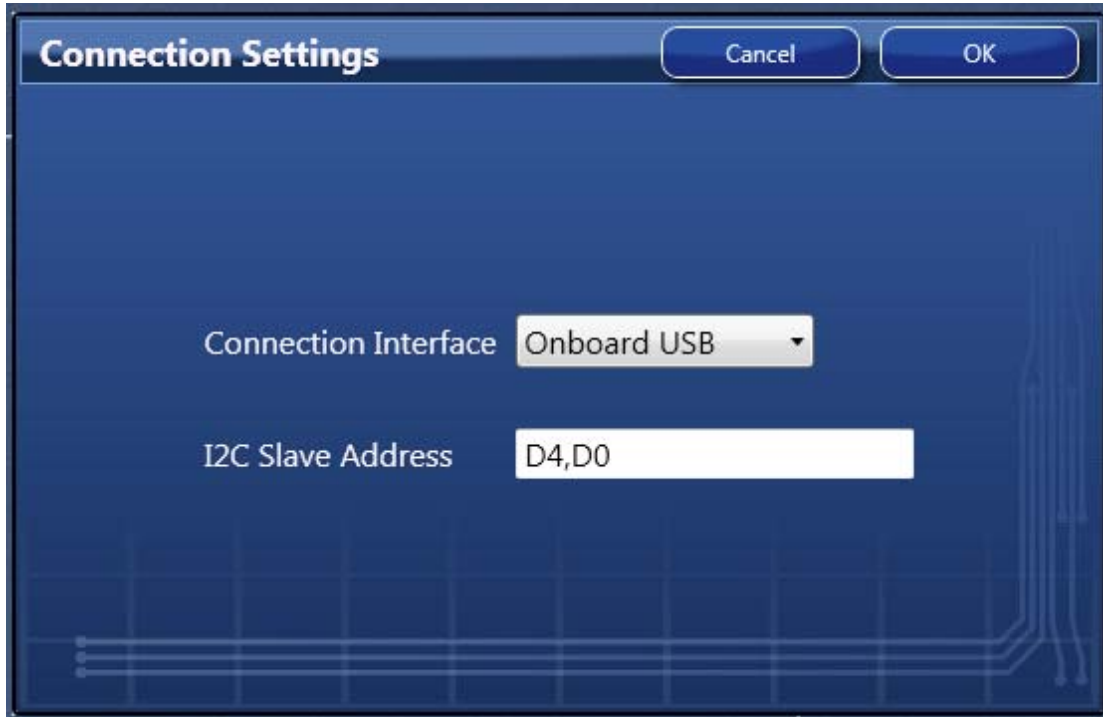
7. **Save the Settings File** – After the configuration is complete, click on the disk symbol at the upper left corner to save the setting file, as shown below.

Figure 12. Save the Setting File



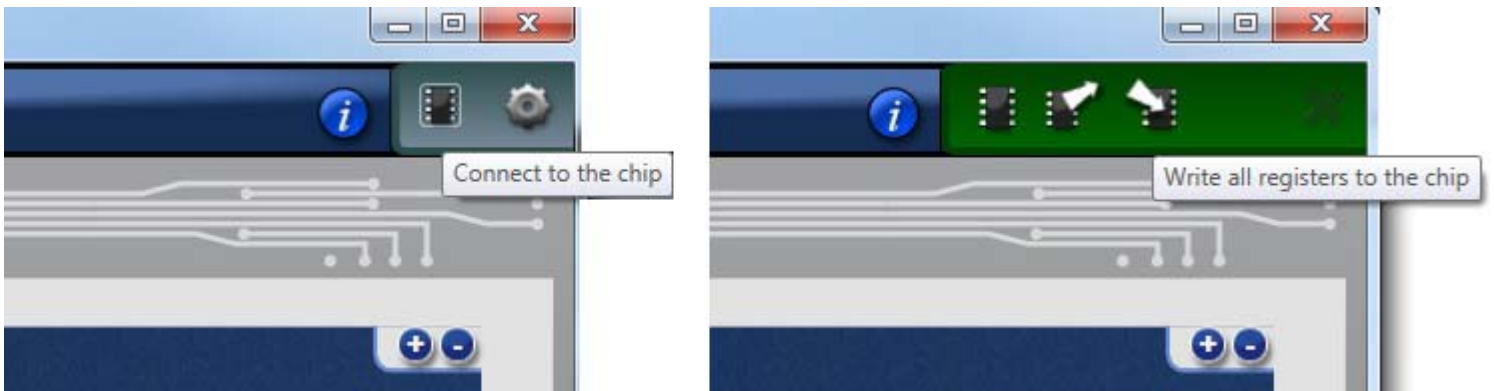
8. **Connecting to the Chip** – If an evaluation board is connected, the settings can be written to the chip registers through I<sup>2</sup>C interface. In GUI software, the connection to the chip can be made by clicking on the round button at upper right corner of the GUI, as shown in Figure 13 below.

**Figure 13. Connection Settings for Connecting to the Chip**



Use the default values in Connection Settings window and click OK to close it. Then click the chip symbol in the corner to bring out read/write command. When the connection is functioning, the area will turn green with “read” or “write” indicators. Please see Figure 14 below. The arrow pointing out of the chip means “reading from the chip”; the arrow pointing into the chip means “writing in the chip”.

**Figure 14. Read from or Writing to Device Registers**



**9. I<sup>2</sup>C Reset, SD/OE Polarity and Global Shutdown**– There are buttons in the left side of the window, as shown below. They have a global impact on the device's operation.

**Figure 15. Buttons for Global Shutdown and SD/OE Polarity Control**



The CLKSEL and SD/OE pins are simulated, the way that the input reference is simulated. That allows the user to see how the part will behave according to the pin states in combination with the bit settings. If the En Global Shutdown (SD) bit is 1, then applying voltage to the SD/OE pin will cause a "global shutdown". It just puts all the outputs into a HI-Z state. It doesn't shut down power to the part. The PLL and dividers are still running. If the SD bit is 0, then SD/OE Polarity (SP bit) determines whether the SD/OE pin is active high (SP=0) or active low (SP=1). If it's active high, it puts the outputs into a HI-LO (off) state, (OUT0 is single ended and just HI) unless the OE bit of an output is low. In which case nothing happens to that output. As long as the SD/OE pin is not active (remembering that active high or low depends on the SP bit), the OE bits on each output do nothing. But when SP is active, then a low OE bit will keep its output active. (OE is active low.) Unless the OS# bit is 0. That will always turn an output off (HI-Z).

Pin 7 (SD/OE) of the device is a dual-function pin. When SH bit (bit 0 of register 0x10) is "1", this pin is SD (shutdown) and when SH bit is "0", this pin is OE (output enable). The active polarity of the pin when it's configured as OE is determined by SP bit (bit 1 of register 0x10). Thus, if the checkbox SD/OE Polarity is checked, please refer to Table 4 in 5P49V5901A datasheet for output status control details.

**SH** is unchecked by default. If checked, it enables a global shutdown.

**10. OTP Programming**– When a configuration is ready for programming, the chip can be programmed right within the Timing Commander GUI software. Clicking on OTP button will bring up OTP Programming window in which one or more configurations can be selected for programming into the device. If **All** box is checked, all 4 configurations will be programmed. The following figure shows the OTP programming selection window.

**Figure 16. OTP Programming within Timing Commander GUI**



To write to OTP, follow these steps:

1. Connect to the part. The "OTP" button becomes enabled. In latest personalities, the "Active" and "Configuration" indicator lights will be displayed, and be illuminated or dark as appropriate. The green "Active" light means that the "OTP Burned"

bit (R0[7]) has been burned. The red "Configuration" lights are illuminated as appropriate: if on, that configuration in the OTP has been burned (see Figure 16a below). Click the "OTP" button.

2. In the OTP dialog, check the boxes of the configurations to be burned. If there are four configurations, there is an "All" checkbox for convenience.
3. Click the "Burn" button. If one or more configurations have not been optimized, there will be a warning. If one or more of the target configurations have already been burned, there will be a warning. (Burning irreversibly converts ones to zeroes; it is possible to go back and burn an unburned bit or bits to zero; zeroes cannot be restored to ones. This allows revision of a burn under limited circumstances.
4. A confirmation message will appear once burn is complete and successful.

**Figure 16a. OTP Active indicator Lights**



**Figure 17. Confirmation Message after OTP Burn**



For loading one or more configurations from a burned part into the GUI ("load OTP") follow these steps:

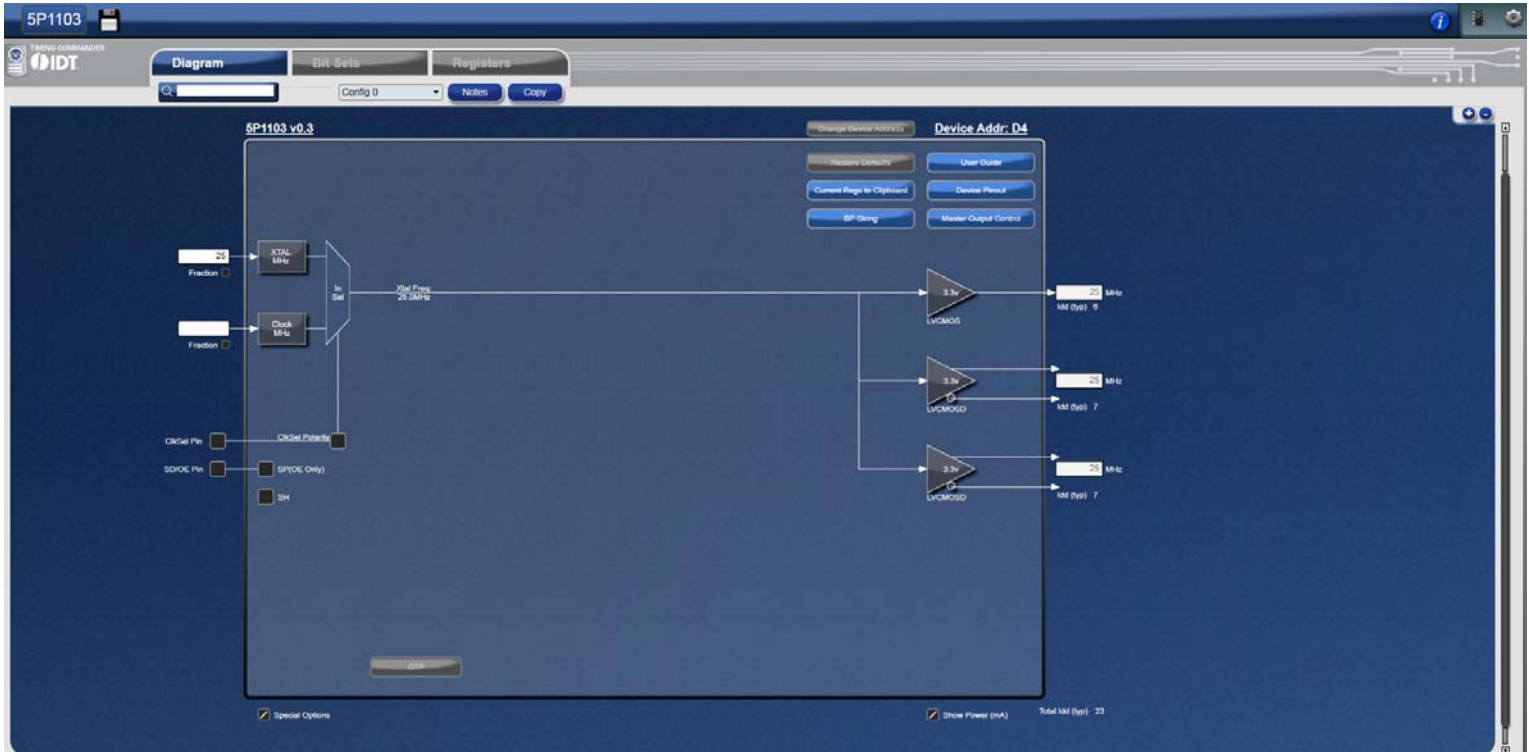
1. Before reading back, cycle the power on the part.
2. Before reading back, set the input crystal and/or clock frequencies in the GUI to those in the original configuration(s). This must be done manually because there is no way to store this information on the part itself. If there is more than one configuration, this step must be repeated for each one.
3. Connect to the part. The "OTP" button becomes enabled. In latest personalities, the "Active" and "Configuration" indicator lights will be displayed, and be illuminated or dark as appropriate. The green "Active" light means that the "OTP Burned" bit (R0[7]) has been burned. The red "Configuration" lights are illuminated as appropriate: if On, that configuration in the OTP has been burned.
4. Click the "OTP" button.
5. In the OTP dialog, check the boxes of the configurations to be loaded. If there are four configurations, there is an "All" checkbox for convenience. If you check a box corresponding to an unburned configuration, there will be a warning. Loading an unburned configuration will load all ones into the GUI and make a mess.
6. Click "Load".

After the loading is complete, the configuration dropdown control at the top can be used to select a specific configuration for display. If the part is still connected, the selected configuration settings will be written to the I2C registers on the part.

Finally, the design of the GUI expects the user to first enter the desired input frequency, followed by the desired output frequency on each clock out. The appropriate register values are then calculated so as to make this happen. If the user then changes the input frequency, the solution is automatically recalculated to produce the same outputs. If the input frequency is changed after settings have been calculated, the output frequencies do not change in proportion. They are treated as targets, and everything else is adjusted to achieve those targets. This is why the input frequencies must be entered before reading back a part.

**5P1103:** It is available along with 5P1105. It has 3 outputs.

**Figure 18. 5P1103 – 2 Universal Output Programmable Clock Buffer and 1 LVCMOS**

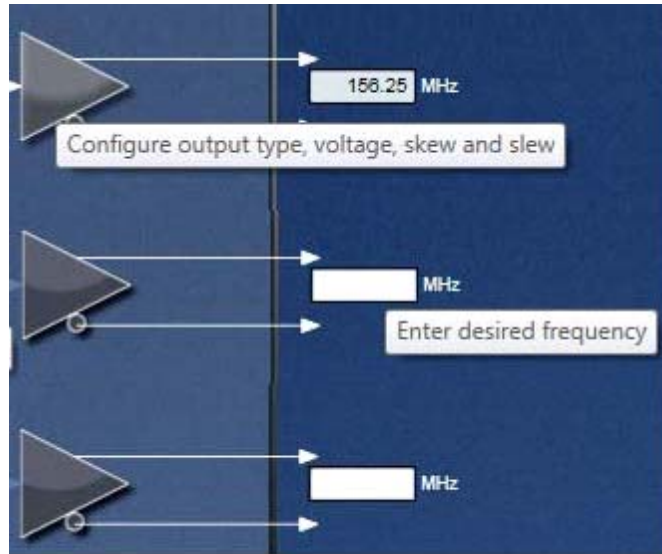




## Getting Further Help

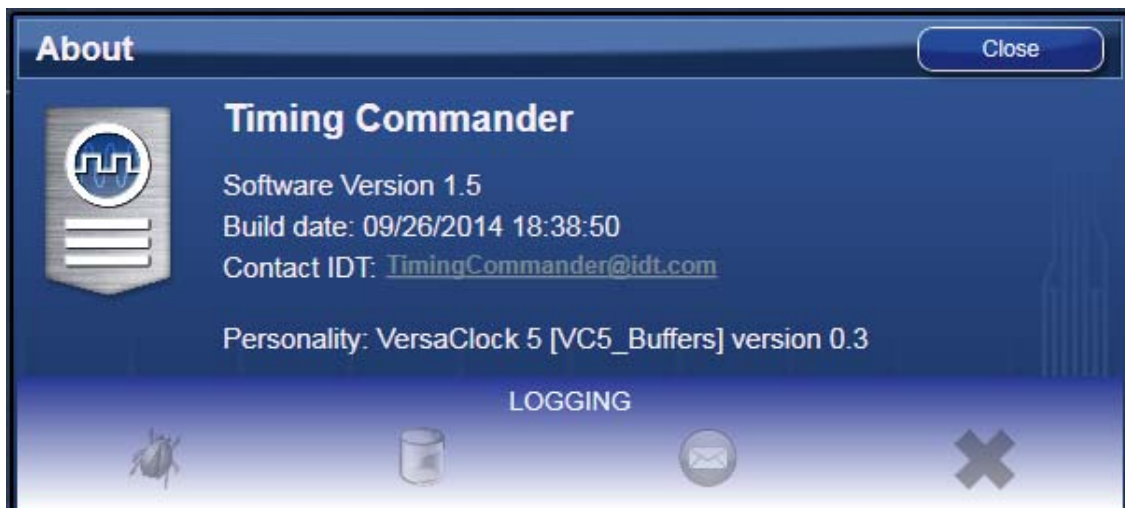
IDT Timing Commander Software is designed to be used interactively. Context-sensitive “tooltips” will appear when the mouse pointer is hovered-over any icon or entry box on the screen. These tooltips will provide information on what function the icon performs and/or limits on values that can be entered into the field. Figure 19 shows an example of such a tooltip indicating an output frequency field when the mouse pointer is hovering over it.

**Figure 19. Tooltip Appears when the Mouse Pointer is Hovering Over any Block in the Window**



The **About** icon on the top-right corner of the screen (blue button with a letter “i”) can be used to generate an E-mail to IDT for assistance (See Figure 20 below), including the option to attach a log file that provides IDT with information on the sequence of operations performed by the user in this session to assist in resolving the user’s concern.

**Figure 20. From About icon, an E-mail can be Generated to IDT with Option of Attaching a Log File**



## Icons Descriptions

### Main Screen Icons



**About** – This icon allows the user to see the version numbers of the IDT Timing Commander Software and the personality currently in use. It also allows the user to contact IDT via Email, with or without attaching a log file to assist in resolution of any issues.



**Error Tab** – Indicates one or more errors are present. Click on this icon to open the Error/Warning Panel if it is not open.



**Warning Tab** – Indicates one or more errors are present. Click on this icon to open the Error/Warning Panel if it is not open.



**Connection Setup** – Clicking on this icon will allow setup of Chip Connect parameters.



**Chip Connect** – Clicking on this icon will cause an attempt to establish a connection with a device in a USB-attached evaluation board (EVB). The device will be tested to determine if it is the device referred to in this personality or not.



**Write to Chip** – Clicking on this icon when located in the top-right corner of the screen will write all registers values to the chip. Clicking on this icon beside a register in Register View will write out only that register to the connected chip.



**Read from Chip** – Clicking on this icon when located in the top-right corner of the screen will read all register values from the chip and replace the internal bit set Values with them, even if they are locked. Clicking on the icon beside a register in Register View will read only this register's Value.

### Icons Associated with Data Entry Boxes



**Error** – There is an error associated with the field this icon is attached to. Hovering over the field with the mouse will bring up a tooltip with more details on the error. The error can also be viewed via the Error/Warning Panel portion of the screen (Error/Warning Panel may need to be expanded by clicking on the Error or Warning tab). Note that a Settings file may not be saved while there are unsolved errors.



**Warning** – There is a warning associated with the field this icon is attached to. Hovering over the field with the mouse will bring up a tooltip with more details on the warning. The warning can also be viewed via the Error/Warning Panel portion of the screen (Error/Warning Panel may need to be expanded by clicking on the Error or Warning tab). Warnings do not prevent saving of a Settings file.



**Modified** – Alerts the user that the value in this field has been modified, either by the user or by the personality from its original value. Clicking on this icon will return the Value to the previous setting and remove the alert.



**Revert** – When this icon is clicked the state will revert back to the previous setting or value entered in the field.

## Types of Data Entry Boxes



**Check Box** – This data entry format is used for binary values that may only be set to 0 (box cleared) or 1 (box checked).



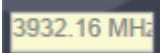
**Bit-by-bit** – This data entry format is used when it makes most sense to set each bit individually. Each bit may be set to 1 or 0 only.



**Combo Box** – This data entry format provides a drop-down menu of selections. Selection values may be fixed or may be adjusted by the personality in response to other fields changing.



**Text Entry** – This data entry format allows direct keyboard entry of values. Values will be checked against the programmed data type for the field as they are typed.



**Read-Only** – This field is read-only. It may not be accessible to the user at all or may have a writable version at another (single) location in the diagram or bit set views.



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