



TRIANGULAR  $\mu$ OS 1.36

for



User's Manual

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# PART A

## PREPARATIONS

# 1. Introduction

TRIANGULAR  $\mu$ OS is a GUI (graphic user interface) operating system for 8-bit Commodore computers. This User's Manual pertains to the TRIANGULAR  $\mu$ OS 1.36 version for Commodore 128.

This package contains files:

- *TRIANGULAR  $\mu$ OS 1.36 for Commodore 128 Users Manual.pdf* – this manual
- *TRIANGULAR  $\mu$ OS 1.36.d81* – image of TRIANGULAR  $\mu$ OS System Disk containing 3 files, which take 45.20 KB (184 disk blocs = 46.00 KB on disk)
- *TRIANGULAR  $\mu$ OS 1.36 SYSTEM DISK* – folder containing all System Disk files for convenient use with SD2IEC
- *TRIANGULAR  $\mu$ OS 1.36 Documents.d81*– empty formatted  $\mu$ OS Documents 1581 type disk image for storing your documents

Goal of creating this system was to develop GUI for 8-bit Commodore computers with lowest amount of memory: that is Commodore PET with at least 4 KB of memory. Next it was expanded for Commodore VIC-20 with standard 5 KB of memory and later with more amount of expansion RAM was required. And in subsequent versions  $\mu$ OS was adapted for Commodore 64, CBM-II and Plus/4. This iteration of TRIANGULAR  $\mu$ OS (version 1.36) is designed to run on Commodore 128.

This software was written in Commodore BASIC language (subset of Microsoft BASIC) using CBM prg Studio 4.2.0 and is designed to run on Commodore 128 in its standard C128 40-column mode. This version of TRIANGULAR  $\mu$ OS is designed to support BASIC 7.0 and works in color text mode. Commodore BASIC (a runtime interpreted language similar in basic concept to JAVA RTM or C# CLI) is default language used in 8-bit Commodore computers and also functions as their OS and user interface. In similar fashion to early Microsoft Windows (1.0 to 3.11),  $\mu$ OS sits atop of BASIC and KERNAL (Commodore's kernel) and Commodore DOS, which is implemented in every Commodore disk drives or 3rd party solutions in order to load  $\mu$ OS programs or modules, load/save settings and documents, perform operations on floppy disks and communicate with disk drive(s).

## 2. What's new

### What's new in TRIANGULAR $\mu$ OS 1.36 for Commodore 128:

- SYSTEM DISK folder added for use with SD2IEC
- GUI: Fixed bug preventing moving windows up and left
- SETTINGS: Fixed labels dislocation when window is moved
- When windows are moved time is now updating
- MATH: Fixed bug in memory operations
- MATH: Fixed bug in reading clipboard values mechanism
- WORDS saves its text files in .txt format instead of .doc
- GAMES folder rearranged: STAR WARS beside SIMCITY, swapped positions with TREASURE
- STAR WARS: Sound effects added to its game engine
- Corrections of minor visual discrepancies
- Improvements and bugfixes
- Updated documentation

### 3. What you need

In order to run TRIANGULAR  $\mu$ OS 1.36, you need either real Commodore 128 with disk drive and joystick to operate cursor or emulator. Printer is optional and can be used as device #4 to #7, although #4 is standard practice and thus recommended.

You can also use freeware VICE emulator, which is available here:  
[vice-emu.sourceforge.io](http://vice-emu.sourceforge.io)

Commodore 128 emulator VICE must be configured with enabled disk drive that can read 800KB 3.5" diskette (.d81 file): recommended Commodore 1581\*. Also, you should enable joystick. You can easily configure it as Numpad keys:

- Up (8), Down (2), Left (4), Right (6)
- You can move diagonally e.g., Up-Left (7)
- 0 or right Ctrl: Fire (click/select)

You can also enable printer in in VICE emulator.  
Do this in: Settings -> Peripheral devices -> Printers. You can choose printer as device #4 - #7, although #4 is standard and is recommended.

*\* Using 5.25" disk drives: 1571 (default), alternatively 1541 type drive (1541-II) is possible, but System Disk and Documents disk images first must be converted to .d71 or .d64 file in external program (e.g., DirMaster). Additionally using 1571 disk drive amounts to over twice disks drive speed reduction, while 1541 type drive bring speed to default Commodore 64 levels (~10 times slower than 1581) thus only 1581 type drive is officially supported.*

PART B

# HOW TO USE TRIANGULAR $\mu$ OS

## 4. How to use TRIANGULAR $\mu$ OS 1.36

Make sure that you are using Commodore in its standard C128 40-column mode. To start TRIANGULAR  $\mu$ OS insert *TRIANGULAR  $\mu$ OS 1.36.d81* disk into disk drive and type either command: *DLOAD "\*" | DLOAD "UOS" | LOAD "\*",8 | LOAD "UOS",8* in BASIC and press Return key (or Enter on PC keyboard in case of emulators). System launcher named UOS will check your computer. If you are using your disk drive as device #8, use one of above commands. If you are using different device # then change last number (8) to it (e.g.: *DLOAD "\*",U9* or *LOAD "\*",9* if you want to use disk drive #9). After successfully loading startup program type RUN (and press Return/Enter) to start  $\mu$ OS.

Now system starts. BIOS is first element of this system. It checks if running machine is indeed Commodore 128 computer, check memory available and checks screen memory. In this stage, if any of above system checks weren't finished successfully,  $\mu$ OS will display error message, beep 3 times and return to default BASIC mode.

Next  $\mu$ OS BIOS proceeds to launchings screen and checks if there are any disk drives, detects their hardware IDs, and if system disk is present, automatically sets boot drive to disk drive containing matching system disk and loads configuration file. If there isn't proper TRIANGULAR  $\mu$ OS System Disk inserted in disk drive or none disk drive has not been detected, error message will be displayed (along with sound of 3 beeps) with possibility to retry detection procedure (F1) or exit to BASIC (F8).

If everything went OK, F1 BIOS SETUP option will appear. By pressing F1 key, you can enter BIOS SETUP menu, where system parameters and list of detected devices like disk drives will be presented. Pressing 1 will disable or enable (default) Commodore Datasette tape recorder from system. To change Boot Drive or Work Drive hit highlighted key (F1 - F8) displayed after name of available disk drive\*. You can also change system time by using T key and entering new time in format HHMMSS left of white arrow or reset system clock by hitting R key. To continue without saving changes (besides time clock which is changed instantly) and go back to launch screen press E key. To save changes and restart  $\mu$ OS use S key. By pressing B key computer shuts down  $\mu$ OS completely by going into its standard BASIC mode. When F1 key is not pressed when launching screen is present, BIOS continues to launching GUI.

*\* If you have another disk drive enabled, you can insert TRIANGULAR  $\mu$ OS 1.36 Documents.d81 or any other disk into second drive and in BIOS Setup menu change Work Disk to that drive number (most probably #9). By doing this you can easily load/save documents on separate disk from TRIANGULAR  $\mu$ OS System Disk (which is recommended setup). Otherwise, you will load/save documents on System Disk (unless you will change disk while working in WORDS word processor), which is default option (Work Disk is set as #8 or other device # of Boot Drive if #8 is not available).*

GUI (graphic user interface) is central element of TRIANGULAR  $\mu$ OS. GUI's is operated by arrow-like sprite mouse pointer which is joystick navigated:

- Up, Down, Right, Left [*or 2,4,6,8 on Numpad in emulator*]
- You can move diagonally – e.g., Up-Left [*or 7 on Numpad in emulator*]
- Fire to select/click [*or 0 / right Ctrl in emulator*]

On bottom of the screen there is task bar with TRIANGULAR logo on center and digital clock on the right side with up arrow symbol to right of the clock. By clicking on this arrow, you will be able to go back directly to initial desktop screen from any window (this is very useful when you want to skip closing previous windows).

By clicking on TRIANGULAR logo, you will open start menu where you can select:

- SETTINGS – opens SETTINGS window
- RESTART – restarts TRIANGULAR  $\mu$ OS
- SHUT DOWN – exits to standard BASIC mode

On main screen desktop there are 4 icons:

- THIS C128 – opens window similar to My Computer or This PC in Microsoft Windows
- APPS – opens folder with selection of apps
- GAMES – opens folder with games
- SETTINGS – opens SETTINGS window

All windows can be moved to another location by simply clicking on theirs Title bar and moving mouse in another position and confirming new position by clicking again.

SETTINGS window is divided on two tabs: SYSTEM and GRAPHIC. SYSTEM tab allows you to change system time (by clicking on + and – signs to change hours, minutes, seconds). Click on RESET CLOCK button to reset system clock. Below label WORD DISK there are buttons with device # (8> to 11>) on them. Red color of those buttons indicate that device is unavailable. Cyan color marks available drive and green show current selected work drive. Clicking on cyan button will change Work Drive to that drive. Below PRINTER label there are buttons to select printer device # (NO, #4 - #7). If NO button is selected (default) no port is assigned and printing functions are not available in TRIANGULAR  $\mu$ OS apps (e.g., WORDS). Select printer device of your printer. Most popular setup is to use printer as device #4. APPLY button saves selection into config file. As in most GUIs clicking on X button closes the window. By doing so without saving, any changes in SETTINGS window (besides time) are canceled.

GRAPHICS tab enables color options. By clicking on one of 16 tiles on right of BACKGR PATTERN label you can change desktop wallpaper pattern. COLOR offers selection of colors for desktop wallpaper. REVERSED will turn reverse of wallpaper patten off/on (enabled with first pattern will change it to solid color). TITLE BAR will change color of title bar of windows. DEAFULT button will reverse colors to default color theme. Don't forget to click on APPLY button to save color changes or exit this window without saving to discard changes.

THIS C128 window contains 2 icons:

- DISK – opens program which shows content of disk and starts programs stored on it
- CMD – starts a disk command prompt program

DISK is a program for viewing disk content. Right of status info with number of files on disk and current page there are buttons with device # (8> to 11>) on them. Red disk button indicate that device is unavailable. Cyan color marks available drive and green show current selected drive. Clicking on cyan/green button will start displaying disk content (on start program will display content of disk inserted in Work Drive). Below is displayed disk name and disk ID. When there no disk in disk drive or disk is empty (not formatted) program will display message: NO DISK! While program retrieves disk content directory from disk drive, label is displayed: CHECKING DISK... F8 ABORT, and pressing F8 key aborts disk checking procedure. Further below there is field for disk content listing, which will display 10 items per page. In both bottom corners of window there are 2 arrows: > (on right) and < arrow (on left) will change page if additional pages of file listing are available. Clicking on program from that list will start it.

CMD is a DOS-like command prompt program that allows you to manage disk content. It accepts one of following commands (disk and file names cannot be longer than 16 characters):

- HELP – shows help
- CLR – clears screen
- EXIT – goes back to desktop
- RESTART – restarts TRIANGULAR  $\mu$ OS
- BASIC – restarts computer to BASIC
- & – displays basic system info
- ! – displays current device info
- #[devide number] – changes disk drive: #1 for Datasette, disk drives 8-11 e.g.: #1, #8, #11
- \$ – shows directory (content) of disk
- ↑[filename] – loads program e.g.: ↑SIMCITY
- ↑ – loads first encountered program (similar to LOAD “\*”,8 in BASIC)
- S>[filename ] – deletes file e.g.: S>SIMCITY
- R>[old name]=[new name] – renames file e.g.: R>OLD NAME=NEW NAME
- C>[original file]=[new file] – copies file e.g.: C>ORIGINAL FILE=NEW FILE
- N>[disk name<id] – formats disk (ID must be 2 charters long) e.g.: N>DISKNAME<ID
- I> – initialize disk
- V> – validates disk

If any of above command will be entered erroneously or with improper parameter(s) error message INVALID COMMAND! or BAD PARAMETER! will be displayed alongside with beep sound. After any operation user will be informed of its success (message: OK ✓) or descriptive error message will be displayed.

APPS folder contains 4 programs: WORDS, MATH, MONITOR and SYNTH.

WORDS is a word processor. Use Cursor Up or Cursor Down/Return to change line. Shift + Return to discard changes in current line and advance to next line. All operation evoked by function keys beside F5 (F1-F4 and F8) will pop up confirmation Yes/No prompt. Press F1 to start new file. F2 prints document on printer (you must have printer assigned to any port [#4 - #7] in SYSTEM tab of SETTINGS before printing, otherwise F2 key won't enable printing function). Use F3 key to load document and F4 to save current document to file. F5 inserts tabulation of 10 spaces. F6 key will copy line to clipboard, while F7 will paste copied line or number copied to clipboard in MATH calculator to current line. Pressing Home key will get you to beginning of document and Shift + Home will delete clear current line. Exit by pressing F8.

MATH – is a scientific calculator. To add 2 numbers, first enter 1st number (by keyboard or by cursor by clicking on numbers in purple/blue field). Entered number will appear on right of the B label. Use left arrow button or DEL key to delete 1 digit. Reset B register by clicking on C button or pressing C key. Click on = or + button or press = or Return key to store number from B register in A register. Next similarly add 2nd number and then click on + or press + key. Result will be showed in A register (above B register). Other mathematical functions operate similarly: enter 1 or 2 numbers and then press button with given function (keys +, -, \*, /, % also work). Pi button (with  $\pi$  symbol on it) enters  $\pi$  value (3.14...) in register B. Click ON or press O key to reset calculator state. Clicking on A<>B button will swap numbers in registers A and B. A>M will store value of A register in clipboard. M>A button will store number saved to clipboard either in MATH or WORDS program in register A. MC will erase clipboard.

MONITOR is a program that shows and edits computer memory. Memory cell values are displayed in hexadecimal number system (0-F). Possible commands:

- HELP – shows help
- CLR – clears screen
- EXIT – goes back to APPS folder
- E>[*address*] – changes memory from given memory address, one byte after one byte (in prompt type X to cancel, you can type R to repeat previous byte value)
- M>[*address*] – shows memory block of 256 bytes containing given memory address
- F>[*1st address*]-[*2nd address*]=[*byte*] – fills specified memory region with given byte value
- T>[*1st address*]-[*2nd address*]=[*destination address*] – copies specified memory region to another
- S>[*1st address*]-[*2nd address*]=[*start address of other region*] – swaps specified memory region with another
- G>[*address*] – executes machine language program starting at address

SYNTH is sound synthesizer program. F1 and F2 keys will lower/rise sound volume (which is represented by green volumeter). Use keys showed on keyboard scheme to play sound in normal octave. Pressing those keys while holding Shift will play them in higher octave, while holding C= key will play them in lower octave. Use Spacebar to stop playing sound. Pressing function keys F3 - F7 will change voice characteristic. Use F8 key to exit.

GAMES folder contains 4 games:

- SIMCITY – create and develop your city. Move cursor by joystick and press R, C or I key to place Residential, Commercial or Industrial zones. Use Space to build a road. Roads are essential since only land plots with road adjacent to them can further develop into occupied ones and bring revenue to the city.
- STAR WARS: X-Wing vs TIE Fighter – help Luke Skywalker defeat Darth Vader's regiment of TIE Fighters to save galaxy and learn about his biggest secret. Aim at TIE fighters using a joystick and press fire to shoot. Since blast will travel the whole height of the screen, my pro tip is to aim at the top of the target area to have a better chance to hit incoming TIE Fighters. Once the last of them is shot down, Luke will meet with Darth Vader and learn about his biggest secret.
- CRAB IN NEW YORK – help crab to cross busy New York City streets. Use the joystick to guide cute crab through the dangerous streets of New York City. Avoiding cars and subways, reach the upper side of the screen to complete each of 9 levels. With each level New York City drivers become more and more frenzy.
- TREASURE CHAMBER – collect treasure/coins and simultaneously evade ghosts that are pursuing you. Use joystick to navigate character.

# APPENDICES

## A. Troubleshooting

Loading of module of TRIANGULAR  $\mu$ OS can “freeze” in process of inter-loading next  $\mu$ OS module or disk program (a very rare occurrence). This happens when loading screen do not proceed to next module for over 1 minute. When loading screen is not responsive for longer time, it can mean error in inter-loading procedure, most probably keyboard buffer was not filled with keys properly. To see what really happened change color of cursor to blue (press Control + 7) and enter command COLOR 0,2 and hit Return key. This should change background color to white which will show underlying black text of loading sequence message. If computer doesn't change cursor or background color try again. If still there is no effect it might be real freeze. If color change procedure succeeds, try using RUN command to see if program will start or go to top of screen (Home key) and press Return in order try to reload program. If it will load successfully enter RUN command. If that not work check if load command is correct. It should have format: LOAD “[*filename*]”, [device # (1 or 8 - 11)] like in e.g.: LOAD “GUI”, 8. If none of it works then start system anew. To prevent this kind of freeze, try not to use keyboard when inter-loading procedure is performed (it can slip improper key into keyboard buffer, which most often leads to this error).

## B.Support & Legal note

More information about TRIANGULAR  $\mu$ OS for Commodore 128 and other computer systems is available on TRIANGULAR  $\mu$ OS website, where you can download SDK, report bug or get help: [triangular-uos.blogspot.com](http://triangular-uos.blogspot.com)

### **LEGAL NOTE:**

TRIANGULAR  $\mu$ OS is free and open software which you can freely copy, share and edit, but give credit to its creators (especially 3rd party games creators).

## C. Changelog

### **TRIANGULAR $\mu$ OS 1.36 for Commodore 128 [04-12-2023]:**

- SYSTEM DISK folder added for use with SD2IEC
- GUI: Fixed bug preventing moving windows up and left
- SETTINGS: Fixed labels dislocation when window is moved
- When windows are moved time is now updating
- MATH: Fixed bug in memory operations
- MATH: Fixed bug in reading clipboard values mechanism
- WORDS saves its text files in .txt format instead of .doc
- GAMES folder rearranged: STAR WARS beside SIMCITY, swapped positions with TREASURE
- STAR WARS: Sound effects added to its game engine
- Corrections of minor visual discrepancies
- Improvements and bugfixes
- Updated documentation

### **TRIANGULAR $\mu$ OS 1.35 for Commodore 128 [23-06-2023]:**

- BIOS improved and bug fixed
- Movable windows by clicking on title bar
- Mouse pointer change when in moving window mode
- Mouse pointer change to hourglass when waiting
- Desktop icons layout rearrangement
- Start menu orb from sprite
- MATH bug fixed
- GUI cleaned up and improved
- Sprites without flickering
- Updated loader graphic using sprite stripes
- Border COLOR reinforced
- Code refactored
- CMD and MONITOR text area handled by WINDOW command
- CMD info properly display amount of free memory from both memory banks
- MONITOR function calling machine program is much simpler
- Drive detection database is held in DATA statements
- CRAB IN NEW YORK error in which 1 collision with cars or trains takes 2 lives is bug fixed plus minor improvements
- STAR WARS: X-Wing vs TIE Fighter game added
- DO...WHILE...LOOP...UNTIL...EXIT and BEIN...BEND commands implemented
- FAST and SLOW utilized to speed up drawing PETSCII elements of inter-loading, also in BIOS and GAMES
- BASICALLY API Window creation function expanded
- BASICALLY API Jump Table added
- Improvements and bugfixes
- SDK adds template windowed program with its source files
- Updated and augmented documentation and SDK documentation now in single PDF file

### **TRIANGULAR $\mu$ OS 1.34 for Commodore 128 [28-05-2023]:**

- Windows loops changes to relative windows position
- Mouse routine improved and mouse position changed
- More BASIC 7.0 commands added
- SIMCITY bug fixed
- CRAB IN NEW YORK, a 3rd game added
- Bugfixes

### **TRIANGULAR $\mu$ OS 1.33 for Commodore 128 [17-05-2023]:**

- Mouse routine reworked and improved
- BASICALLY API Window creator reworked with window displaying mechanism
- TREASURE CHAMBER, game by Fabrizio Caruso added
- More BASIC 7.0 commands added (IF...THEN...ELSE, SLEEP) and RESTORE command expanded
- Bugfixes

### **TRIANGULAR $\mu$ OS 1.32 for Commodore 128 [11-02-2023]:**

- BASIC 7.0 WINDOW command utilized
- Enlarged DESKTOP area
- Change versioning scheme and version held as numeric value in memory
- Change file system from filename>ext (extension) to filename.ext (extension)  
e.g.: uos>cfg to uos.cfg
- BASIC 7.0 sound commands implemented
- Minor improvements and bugfixes

### **TRIANGULAR $\mu$ OS 1.31/C128 for Commodore 128 [15-01-2023]:**

- Mouse pointer routines redesigned which resulted in twice faster movements
- Some additional graphic operations converted to BASIC 7.0 syntax
- Minor improvements and bugfixes

### **TRIANGULAR $\mu$ OS 1.30/C128 for Commodore 128 [12-01-2023]:**

- Commodore 128 in its standard 40 column VIC-II C128 mode is supported
- Only 3.5" 1581 type disk drive is supported
- Loading and saving is 10x faster due to faster C128 1581 disk drive handling
- Color theme changed from C64 blue to C128 pyramids
- BASIC 7.0 handles sprites and few needed instructions added
- GAMES folder contains only SIMCITY, other 3 games removed
- Minor improvements and bugfixes
- Changelog is revised and integrated back into User's Manual