OpenTX 2.1 Lua Reference Guide

OpenTX Development Team

Published with GitBook

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This guide covers the development of user-written scripts for R/C transmitters running the OpenTX 2.1 operating system with Lua support. Readers should be familiar with OpenTX, the OpenTX Companion, and know how to transfer files the SD card in the transmitter.

Part I of the guide shows how to enable Lua support for Taranis and includes basic examples of each types of script.

Part II is a programming guide and introduces the types of OpenTX Lua scripts and how they can be used.

Part III is the OpenTX Lua API Reference

Part IV addresses common issues in converting Lua scripts that were originally written for OpenTX 2.0

Part V covers advanced topics with examples

last updated on 2016/12/17 20:14:31 UTC

Introduction

This section includes Acknowledgments and Getting Started.

Acknowledgments

The OpenTX team has no intention of making a profit from their work. OpenTX is free and open source and will remain free and open source. But OpenTX is more expensive to maintain than most open source projects. The reason is that there is a never ending flood of hardware to integrate and maintain code for. Hardware that costs.

Another reason is that OpenTX maintains a build server that serves firmware compiled on demand. This is where OpenTX Companion orders your customized firmware. The server is not for free and the bandwidth is ever increasing with tens of thousands of firmware downloads each month.

The OpenTX team is grateful to those who have donated to the project. You have helped making OpenTX and OpenTX Companion great.

The Github Donor List is updated at each OpenTX release.

If you would like to contribute to OpenTX, donations are welcome and appreciated:

Getting Started

Downloading OpenTX Companion

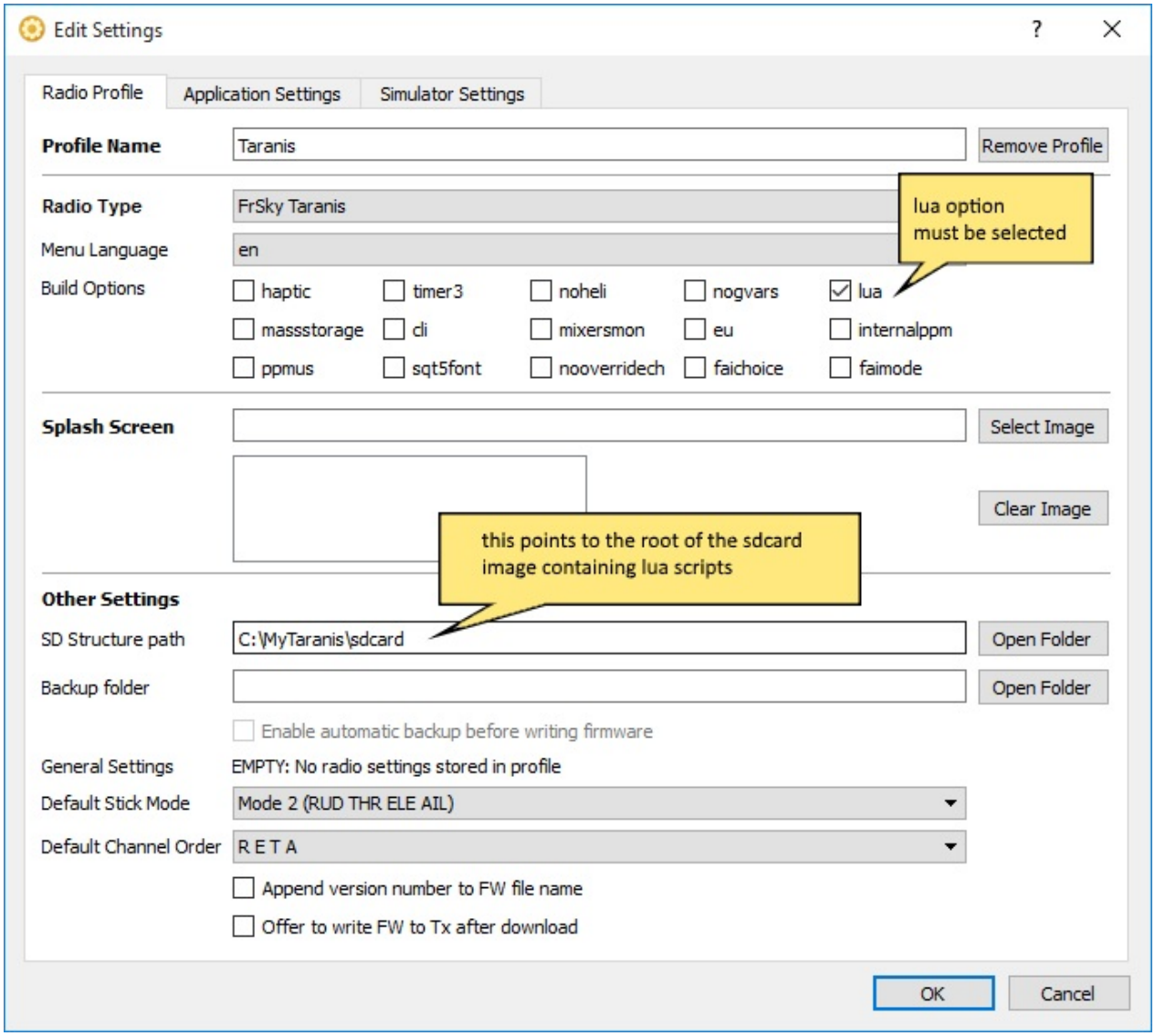
OpenTX Companion 2.1 is available for download at http://www.open-tx.org/downloads.html

This is major version with completely new telemetry handling. Please read this thread before upgrading from a previous version, and carefully check the changelogs on each upgrade. This branch is the first to support the FrSky Taranis X9E (tray version).

Updating firmware with Lua option selected

If you intend to use mixer scripts, when updating the firmware on your transmitter you need to make sure the lua option is checked in the settings for your radio profile (Main menu -> Settings ->Settings...) as shown below. This is not required if you only intend to run telemetry, one-time and function scripts, support for those is included by default.

Also note that the SD Structure path should contain a valid path to a copy of your transmitter's SD card contents, although that's not specific to Lua.



Edit Settings dialog from OpenTX Companion

Part I - Script Type Overview

This section introduces the types of Lua scripts supported by OpenTX and how they may be used.

Mix Scripts

***WARNING* - Do not use Lua mix scripts for controlling any aspect of your model that could cause a crash if script stops executing.**

Description

Each model can have several mix scripts associated with it. These scripts are run periodically for entire time that model is selected. These scripts behave similar to standard OpenTX mixers but at the same time provide much more flexible and powerful tool.

Mix scripts take one or more values as inputs, do some calculation or logic processing based on them and output one or more values. Each run of a script should be as short as possible. Exceeding the script execution runtime limit will result in the script being forcefully stopped and disabled.

Typical uses

- replacement for complex mixes that are not critical to model function
- complex processing of inputs and reaction to their current state and/or their history
- filtering of telemetry values

Limitations

- cannot update LCD screen or perform user input.
- should not exceed allowed run-time/ number of instructions.
- mix scripts are run with less priority than built-in mixes. Their execution period is around 30ms and is not guaranteed!
- can be disabled/killed anytime due to logic errors in script, not enough free memory, etc...)

Location

Place them on SD card in folder /SCRIPTS/MIXES/

Lifetime

- script is loaded from SD card when model is selected
- script *init* function is called
- script *run* function is periodically called (inside GUI thread, period cca 30ms)
- script is stopped and disabled if it misbehaves (too long runtime, error in code, low memory)
- all mix scripts are stopped while one-time script is running (see Lua One-time scripts)

Script interface definition

Every script must include a *return* statement at the end, that defines its interface to the rest of OpenTX code. This statement defines:

- script *input* table (optional, see Input Table Syntax)
- script *output* table (optional, see Output Table Syntax)
- script *init* function (optional, see Init Function Syntax)
- script *run* function (see Run Function Syntax)

Example (interface only):

```
local input {}

local output {}

local function init_func()
end

local function run_func()
end

return { input=input, output=output, run=run_func, init=init_func }
```

Notes:

- inputs table defines input parameters (name and source) to run function (see Input Table Syntax)
- outputs table defines names for values returned by run function (see Output Table Syntax)
- init_func() function is called once when script is loaded.
- run_func() function is called periodically

Telemetry Scripts

General description

Telemetry scripts are used for building customized screens. Each model can have up to three active scripts as configured on the model's telemetry configuration page. The same script can be assigned to multiple models.

File Location

Scripts are located on the SD card in the folder /SCRIPTS/TELEMETRY/<*name*>.lua (*name* must be in 8 characters or less).

Lifetime of telemetry script

Telemetry scripts are started when the model is loaded.

- script init function is called
- script background function is periodically called when custom telemetry screen is **not visible**. *Notice*:
  - In OpenTX 2.0 this function is **not called** when the custom telemetry screen is visible.
  - In OpenTX 2.1 and successors this function is **always called** no matter if the custom screen is visible or not.
- script run function is periodically called when custom telemetry screen is **visible**
- script is stopped and disabled if it misbehaves (too long runtime, error in code, low memory)
- all telemetry scripts are stopped while one-time script is running (see Lua One-time scripts)

Script interface definition

Every script must include a return statement at the end, that defines its interface to the rest of OpenTX code. This statement defines:

- script **init** function *(optional)*
- script **background** function
- script **run** function

Example (interface only):

```
local function init_func()
  -- init_func is called once when model is loaded
end

local function bg_func()
  -- bg_func is called periodically when screen is not visible
end

local function run_func(key-event)
  -- run_func is called periodically when screen is visible
  bg_func() -- run typically calls bg_func to start
end

return { run=run_func, background=bg_func, init=init_func  }
```

Notes:

- *init_func()* function is called once when script is loaded and begins execution.
- *bg_func()* is called periodically when custom telemetry screen is not visible.
- *run_func(key-event)* function is called periodically when custom telemetry screen is visible. The *key-event* parameter indicates which transmitter button has been pressed (see Key Events)

One-Time Scripts

Overview

One-Time scripts start when called upon by a specific radio function or when the user selects them from a contextual menu. They do their task and are then terminated and unloaded. Please note that all persistent scripts are halted during the execution of one time scripts. They are automatically restarted once the one time script is finished. This is done to provide enough system resources to execute the one time script.

WARNING! -

- Running a One-Time script will suspend execution of all other currently loaded Lua scripts (Mix, Telemetry, and Functions)

File Location

Place them anywhere on SD card, the folder /SCRIPTS/ is recommended. The only exception is official model wizard script, that should be put into /SCRIPTS/WIZARD/ folder that way it will start automatically when new model is created.

Lifetime of One-Time scripts

Script is executed when user selects Execute on a script file from SD card browser screen.

Script executes until:

- it returns value different from 0
- is forcefully closed by user by long press of EXIT key
- is forcefully closed by system if if it misbehaves (too long runtime, error in code, low memory)

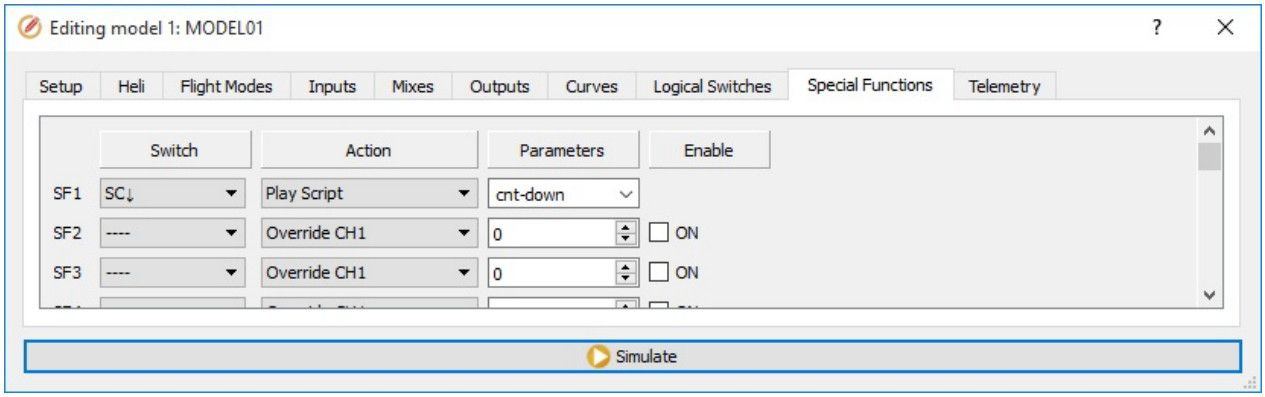
Wizard

TODO: Need to determine status of wizard in 2.1

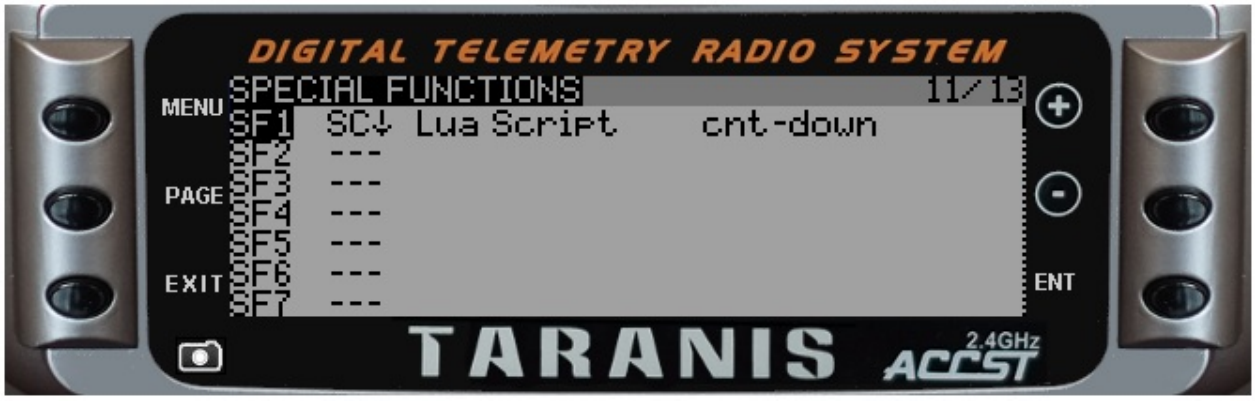
Function Scripts

Overview

Function scripts are invoked via the **'Lua Script'** option of Special Functions configuration page.



Companion Special Functions Window



Taranis Special Functions Display

Typical uses

- specialized handling in response to switch position changes
- customized announcements

Limitations

- should not exceed allowed run-time/ number of instructions.
- all function scripts are stopped while one-time script is running (see Lua One-time

scripts)
- Version 2.1 function scripts **DO NOT HAVE ACCESS TO LCD DISPLAY**

Location

Place them on SD card in folder /SCRIPTS/FUNCTIONS/

Lifetime

- script *init* function is called once when model is loaded
- script *run* function is periodically called as long as switch condition is true
- script is stopped and disabled if it misbehaves (too long runtime, error in code, low memory)

Script interface definition

Every script must include a *return* statement at the end, that defines its interface to the rest of OpenTX code. This statement defines:

- script *init* function (optional, see Init Function Syntax)
- script *run* function (see Run Function Syntax)

Example (interface only):

```
local function init_func()
end

local function run_func()
end

return { run=run_func, init=init_func }
```

Notes:

- local variables retain their values for as long as the model is loaded regardless of switch condition value

Advanced example (save as /SCRIPTS/FUNCTIONS/cnt-down.lua)

The script below is an example of customized countdown announcements. Note that the init function determines which version of OpenTX is running and sets the unit parameter for playNumber() accordingly.

```


local lstannounce
```

```
local target

local running = false

local duration = 120 -- two minute countdown
local announcements = { 120, 105, 90, 75, 60, 55, 50, 45, 40, 35, 30, 29, 28, 27, 26,
25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2
, 1, 0}
local annIndex

local minUnit

local function init()
  local version = getVersion()
  if version < "2.1" then
    minUnit = 16 -- must be running OpenTX 2.0
  else
    minUnit = 23
  end
end

local function run()

  local timenow = getTime() -- 10ms tick count
  local remaining
  local minutes
  local seconds

  if not running then
    running = true
    target = timenow + (duration * 100)
    annIndex = 1
  end

  remaining = math.floor(((target - timenow) / 100) + .7) --  +.7 adjust for announcem
ent lag

  if remaining < 0 then
    running = false -- we were 'paused' and missed zero
    return
  end

  while remaining < announcements[annIndex] do
    annIndex = annIndex + 1 -- catch up in case we were paused
  end

  if remaining == announcements[annIndex] then
    minutes = math.floor(remaining / 60)
    seconds = remaining % 60
    if minutes > 0 then
      playNumber(minutes, minUnit, 0)
    end
    if seconds > 0 then
```

```
        playNumber(seconds, 0, 0)
      end
      annIndex = annIndex + 1
    end

    if remaining <= 0 then
      playNumber(0,0,0)
      running = false
    end

  end

  return { init=init, run=run }
```

Part II - OpenTX Lua API Programming Guide

This section provides more specifics on the OpenTX Lua implementation. Here you will find syntax rules for interface tables and functions. Also included is a table showing which of the available Lua libraries are accessible to OpenTx scripts.

Input Table Syntax

Overview

The input table defines what values are available as input(s) to mix scripts. There are two forms of input table entries.

- **SOURCE syntax**

  ```
  { "<name>", SOURCE }
  ```

  SOURCE inputs provide the current value of a selected OpenTX variable. The source must set by the user when the mix script is configured. Source can be any value OpenTX knows about (inputs, channels, telemetry values, switches, custom functions,...).
  Note: typical range is -1024 thru +1024. Simply divide the input value by 10.24 to interpret as a percentage from -100% to +100%.

- **VALUE syntax**

  ```
  { "<name>", VALUE, <min>, <max>, <default> }
  ```

  VALUE inputs provide a constant value that is set by the user when the mix script is configured.

  - *name* - maximum length of 8 characters
  - *min* - minimum value of -128
  - *max* - maximum value of 127
  - *default* - must be within the valid range specified

- **Maximum of 8 inputs per script (Warning : will be reduced from 8 to 6 in 2.2)**

Example using a SOURCE and a VALUE

```
local input =
    {
        { "Strength", SOURCE},                -- user selects source (typically slider
 or knob)
        { "Interval", VALUE, 0, 100, 0 }    -- interval value, default = 0.
    }

local function run(strength, interval)
    -- variable strength will contain the current slider value
    -- variable interval is set by the user and constant through script lifetime

    -- this script has no return value but may use playFile() to alert user

    return
end

return {input=input, run=run}
```

Output Table Syntax

Overview

Outputs are only used in mix scripts. The output table defines only name(s), the actual values are determined by the script's run function.

```
{ "<name1>", "<name2>" }
```

Example:

```
local output { "Val1", "Val2" }

local function run()
    return 0, -1024 -- these values will be available in OpenTX as Val1 and Val2
end

return {output=output, run=run}
```

Notes:

- Output name is limited to four characters.
- A maximum of 6 outputs are supported
- Number Format Outputs are 16 bit signed integers when they leave Lua script and are then divided by 10.24 to produce output value in percent:

Script Return Value	Mix Value in OpenTX
0	0%
996	97.2%
1024	100%
-1024	-100%

Init Function Syntax

If defined, *init* function is called right after the script is loaded from SD card and begins execution. Init is called only once before the run function is called for the first time.

```
local function <init_function_name>()
  -- code here runs only once when the model is loaded
end
```

- **Input Parameters:**

  none

- **Return values:**

  none

Run Function Syntax

The run function is the function that is periodically called for the lifetime of script execution. Syntax of the run function is different between mix scripts and telemetry scripts.

Run Function for Mix Scripts

```
local function <run_function_name>([first input, [second input], …])

   -- if mix has no return values
   return

   -- if mix has two return values
   return value1, value2

end
```

- **Input parameters:**

  zero or more input values, their names are arbitrary, their meaning and order is defined by the input table. (see Input Table Syntax)

- **Return values:**

  - none - if output table is empty (i.e. script has no output) values
    - or -
  - comma separated list of output values, their order and meaning is defined by the output table. (see Output Table Syntax)

Run Function for Telemetry Scripts

```
local function <run_function_name>(key-event)
  return 0 -- values other than zero will halt the script
end
```

- **Input parameters:**

  The *key-event* parameter indicates which transmitter button has been pressed (see Key Events)

- **Return values:**

  A non-zero return value will halt the script

Return Statement Syntax

The return statment is the last statement in an OpenTX Lua script. It defines the input/output table values and functions used to run the script.

Parameters *init*, *input* and *output* are optional. If a script doesn't use them, they can be omitted from return statement.

Example without *init* and *output*:

```
local inputs = { { "Aileron", SOURCE }, { "Ail. ratio", VALUE, -100, 100, 0 } }

local function run_func(ail, ratio)
    -- do some stuff
    if (ail > 50) and ( ratio < 40) then
        playFile("foo.wav")
    end
end

-- script that only uses input and run
return { run=run_func, input=inputs }
```

The following Lua libraries are available in OpenTx

Lua Standard Libraries	Included
package	-
coroutine	-
table	-
io	since OpenTX 2.1.0 (with limitations)
os	-
string	since OpenTX 2.1.7
bit32	since OpenTX 2.1.0
math	since OpenTX 2.0.0
debug	-

io library

The **io** library has been simplified and only a subset of functions and their functionality is available. What follows is a complete reference of io functions that are available to OpenTX scripts

Available functions:

- io.open()
- io.close()
- io.read()
- io.write()
- io.seek()

Examples

Read the whole file

```
-- this is an OpenTX stand-alone script

local function run(event)
  print("lua io.read test")         -- print() statements are visible in Debug output
window
  local f = io.open("foo.bar", "r")
  while true do
    local data = io.read(f, 10)     -- read up to 10 characters (newline char also cou
nts!)
    if #data == 0 then break end    -- we get zero length string back when we reach en
d of the file
    print("data: "..data)
    end
  io.close(f)
  return 1
end

return {  run=run }
```

Append data to file

```
-- this is an OpenTX stand-alone script

local function run(event)
  print("lua io.write test")
  local f = io.open("foo.bar", "a")        -- open file in append mode
  io.write(f, "first line\r\nsecond line\r\n")
  io.write(f, 4, "\r\n", 35.6778, "\r\n")  -- one can write multiple items at the same
 time
  local foo = -4.45
  io.write(f, foo, "\r\n")
  io.close(f)
  return 1    -- this will end the script execution
end

return { run=run }
```

io.open(<filename> [, <mode>])

The io.open() function is used to open the file on SD card for subsequent reading or writing. After the script is done with the file manipulation io.close() function should be used.

Notice: this functions is fully functional from OpenTX 2.1.5.

Parameters

- `filename` full path to the file starting from the SD card root directory. This function can't create a new file in non-existing directory.
- `mode` supported mode strings are:
  - `"r"` read access. File must exist beforehand. The read pointer is located at the beginning of file. This is the default mode if is omitted.
  - `"w"` write access. File is opened or created (if it didn't exist) and truncated (all existing file contents are lost).
  - "a" write access. File is opened or created (if it didn't exist) and write pointer is located at the end of the file. The existing file contents are preserved.

Return value

- `<file object>` if file was successfully opened.
- `nil` if file could not be opened.

io.close(<file object>)

The io.close() function is used to close open file.

Parameters

- `file object` a file object that was returned by the io.open() function.

Return value

- none

io.read(<file object> , <length>)

The io.read() function is used to read data from the file on SD card.

Notice: other read *commands* (like "*all", etc..) are *not supported*.

Parameters

- `file object` a file object that was returned by the io.open() function. The file must be opened in read mode.
- `length` number of characters/bytes to read. The number of actual read/returned characters can be less if the file end is reached.

Return value

- `<string>` a string with a length equal or less than
- `""` a zero length string if the end of file was reached

io.write(<file object> , <data>[, <data>, ...])

The io.write() function is used to write data to the file on SD card.

Parameters

- `file object` a file object that was returned by the io.open() function. The file must be opened in write or append mode.
- `data` any Lua type that can be converted into string. If more than one data parameter is used their contents are written to the file by one in the same order as they are specified.

Return value

- `<file object>` if data was successfully opened.
- `nil, <error string>, <error number>` if the data can't be written.

io.seek(<file object> , <offset>)

The io.seek() function is used to move the current read/write position.

Notice: other read standard seek bases (like "cur", "end") are **not supported**.

Parameters

- `file object` a file object that was returned by the io.open() function.
- `offset` position the read/write file pointer at the specified offset from the beginning of the file. If specified offset is bigger than the file size, then the pointer is moved to the end of the file.

Return value

- `0` success
- `<number>` any other value means failure.

Part III - OpenTX Lua API Reference

Constants

Key Event Constants

Key Event Name	Comments
EVT_MENU_BREAK	
EVT_PAGE_BREAK	
EVT_PAGE_LONG	
EVT_ENTER_BREAK	
EVT_ENTER_LONG	
EVT_EXIT_BREAK	
EVT_PLUS_BREAK	
EVT_MINUS_BREAK	
EVT_PLUS_FIRST	
EVT_MINUS_FIRST	
EVT_PLUS_RPT	
EVT_MINUS_RPT	

General Functions

GREY()

Returns gray value which can be used in LCD functions

Parameters

none

Return value

- `(number)` a value that represents amount of *greyness* (from 0 to 15)

defaultChannel(stick)

Get channel assigned to stick. See Default Channel Order in General Settings

@status current Introduced in 2.0.0

Parameters

- `stick` (number) stick number (from 0 to 3)

Return value

- `number` channel assigned to this stick (from 0 to 3)
- `nil` stick not found

defaultStick(channel)

Get stick that is assigned to a channel. See Default Channel Order in General Settings.

@status current Introduced in 2.0.0

Parameters

- `channel` (number) channel number (0 means CH1)

Return value

- `number` Stick assigned to this channel (from 0 to 3)

getDateTime()

Return current system date and time that is kept by the RTC unit

Parameters

none

Return value

- `table` current date and time, table elements:
  - `year` (number) year
  - `mon` (number) month
  - `day` (number) day of month
  - `hour` (number) hours
  - `min` (number) minutes
  - `sec` (number) seconds

Examples

general/getDateTime-example

```
local function run(e)
  local datenow = getDateTime()
  lcd.clear()
  lcd.drawText(1,1,"getDateTime() example",0)
  lcd.drawText(1,11,"year, mon, day: ", 0)
  lcd.drawText(lcd.getLastPos()+2,11,datenow.year..", "..datenow.mon..", "..datenow.da
y,0)
  lcd.drawText(1,21,"hour, min, sec: ", 0)
  lcd.drawText(lcd.getLastPos()+2,21,datenow.hour..", "..datenow.min..", "..datenow.se
c,0)
end

return{run=run}
```


DIGITAL TELEMETRY RADIO SYSTEM
MENU
PAGE
EXIT
ENT
getDateTime() example
year, mon, day: 2015, 10, 8
hour, min, sec: 19, 5, 21
TARANIS
2.4GHz
ACCST

getFieldInfo(name)

Return detailed information about field (source)

The list of valid sources is available:

- for OpenTX 2.0.x at http://downloads-20.open-tx.org/firmware/lua_fields.txt
- for OpenTX 2.1.x at http://downloads-21.open-tx.org/firmware/lua_fields.txt (depreciated)
- for OpenTX 2.1.x Taranis and Taranis Plus at http://downloads-21.open-tx.org/firmware/lua_fields_taranis.txt
- for OpenTX 2.1.x Taranis X9E at http://downloads-21.open-tx.org/firmware/lua_fields_taranis_x9e.txt

In OpenTX 2.1.x the telemetry sources no longer have a predefined name. To get a telemetry value simply use it's sensor name. For example:

- Altitude sensor has a name "Alt"
- to get the current altitude use the source "Alt"
- to get the minimum altitude use the source "Alt-", to get the maximum use "Alt+"

@status current Introduced in 2.0.8

Parameters

- `name` (string) name of the field

Return value

- `table` information about requested field, table elements:
  - `id` (number) field identifier
  - `name` (string) field name
  - `desc` (string) field description
- `nil` the requested field was not found

Examples

general/getFieldInfo-example

```
local function run(e)
  local fieldinfo = getFieldInfo('rs')
  lcd.clear()
  lcd.drawText(1,1,"getFieldInfo() example",0)
  if fieldinfo then
    lcd.drawText(1,11,"id: ", 0)
    lcd.drawText(lcd.getLastPos()+2,11,fieldinfo['id'],0)
    lcd.drawText(1,21,"name: ", 0)
    lcd.drawText(lcd.getLastPos()+2,21,fieldinfo['name'],0)
    lcd.drawText(1,31,"desc: ", 0)
    lcd.drawText(lcd.getLastPos()+2,31,fieldinfo['desc'],0)
  else
    lcd.drawText(1,11,"Requested field not available!", 0)
  end
end

return{run=run}
```

getFlightMode(mode)

Return flight mode data.

@status current Introduced in 2.1.7

Parameters

- `mode` (number) flight mode number to return (0 - 8). If mode parameter is not specified (or contains invalid value), then the current flight mode data is returned.

Return value

- `multiple` returns 2 values:
  - (number) (current) flight mode number (0 - 8)
  - (string) (current) flight mode name

getGeneralSettings()

Returns (some of) the general radio settings

@status current Introduced in 2.0.6, `imperial` added in TODO

Parameters

none

Return value

- `table` with elements:
  - `battMin` (number) radio battery range - minimum value
  - `battMax` (number) radio battery range - maximum value
  - `imperial` (number) set to a value different from 0 if the radio is set to the IMPERIAL units

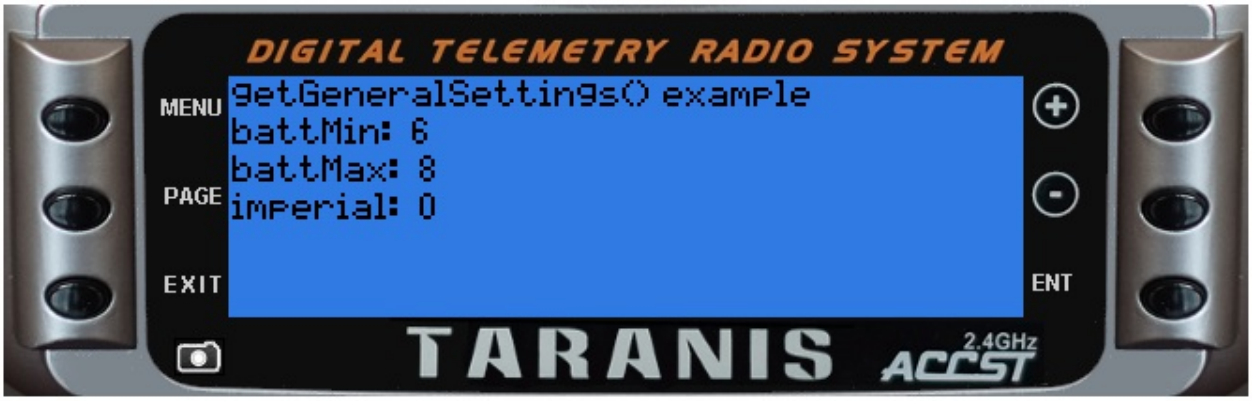
---

Examples

general/getGeneralSettings-example

```
local function run(e)
  local settings = getGeneralSettings()
  lcd.clear()
  lcd.drawText(1,1,"getGeneralSettings() example",0)
  lcd.drawText(1,11,"battMin: ", 0)
  lcd.drawText(lcd.getLastPos()+2,11,settings['battMin'],0)
  lcd.drawText(1,21,"battMax: ", 0)
  lcd.drawText(lcd.getLastPos()+2,21,settings['battMax'],0)
  lcd.drawText(1,31,"imperial: ", 0)
  lcd.drawText(lcd.getLastPos()+2,31,settings['imperial'],0)
end

return{run=run}
```


DIGITAL TELEMETRY RADIO SYSTEM
MENU
PAGE
EXIT
getGeneralSettings() example
battMin: 6
battMax: 8
imperial: 0
ENT
TARANIS
2.4GHz
ACCST

getTime()

Return the time since the radio was started in multiple of 10ms

@status current Introduced in 2.0.0

Parameters

none

Return value

- `number` Number of 10ms ticks since the radio was started Example: run time: 12.54 seconds, return value: 1254

getValue(source)

Returns the value of a source.

The list of valid sources is available:

- for OpenTX 2.0.x at http://downloads-20.open-tx.org/firmware/lua_fields.txt
- for OpenTX 2.1.x at http://downloads-21.open-tx.org/firmware/lua_fields.txt (depreciated)
- for OpenTX 2.1.x Taranis and Taranis Plus at http://downloads-21.open-tx.org/firmware/lua_fields_taranis.txt
- for OpenTX 2.1.x Taranis X9E at http://downloads-21.open-tx.org/firmware/lua_fields_taranis_x9e.txt

In OpenTX 2.1.x the telemetry sources no longer have a predefined name. To get a telemetry value simply use it's sensor name. For example:

- Altitude sensor has a name "Alt"
- to get the current altitude use the source "Alt"
- to get the minimum altitude use the source "Alt-", to get the maximum use "Alt+"

@status current Introduced in 2.0.0, changed in 2.1.0, `Cels+` and `Cels-` added in 2.1.9

Parameters

- `source` can be an identifier (number) (which was obtained by the getFieldInfo()) or a name (string) of the source.

Return value

- `value` current source value (number). Zero is returned for:
  - non-existing sources
  - for all telemetry source when the telemetry stream is not received
- `table` GPS position is returned in a table:
  - `lat` (number) latitude, positive is North
  - `lon` (number) longitude, positive is East
  - `pilot-lat` (number) pilot latitude, positive is North
  - `pilot-lon` (number) pilot longitude, positive is East
- `table` GPS date/time, see getDateTime()

- `table` Cells are returned in a table (except where no cells were detected in which case the returned value is 0):
  - table has one item for each detected cell:
  - key (number) cell number (1 to number of cells)
  - value (number) current cell voltage

Notice

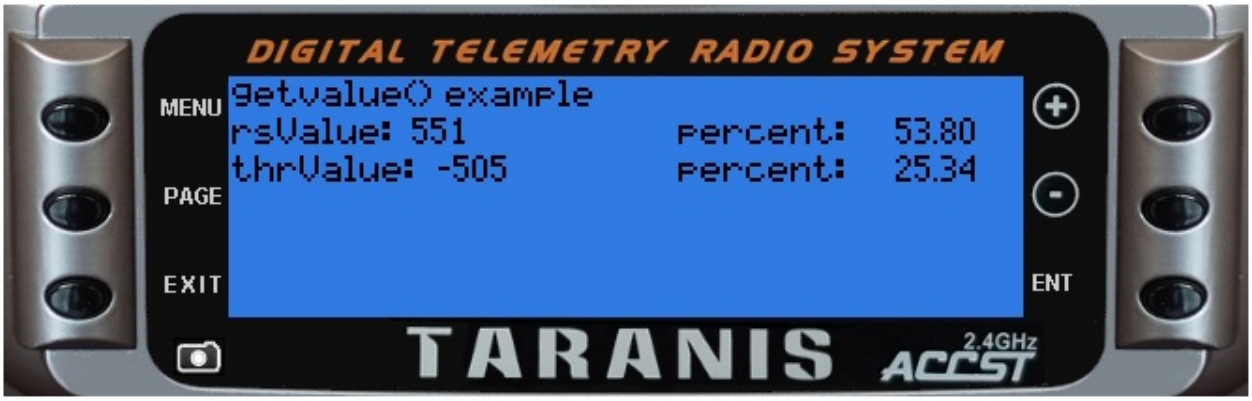
Getting a value by its numerical identifier is faster then by its name. While `Cels` sensor returns current values of all cells in a table, a `Cels+` or `Cels-` will return a single value - the maximum or minimum Cels value.

Examples

general/getValue-example

```
local function run(e)
  --
  -- NOTE: analog values (e.g. sticks and sliders) typically range from -1024 to +1024
  --       divide by 10.24 to scale into -100% thru +100%
  --       or add 1024 and divide by 20.48 to scale into 0% thru 100%
  --
  local rsValue = getValue('rs')
  local thrValue = getValue('thr')
  lcd.clear()
  lcd.drawText(1, 1, "getvalue() example",0)
  lcd.drawText(1, 11, "rsValue: ", 0)
  lcd.drawText(lcd.getLastPos() + 2, 11, rsValue, 0)
  lcd.drawText(120, 11, "percent: ", 0)
  lcd.drawNumber(lcd.getLastPos() + 32, 11, rsValue / 10.24, PREC2)
  lcd.drawText(1, 21, "thrValue: ", 0)
  lcd.drawText(lcd.getLastPos() + 2, 21, thrValue, 0)
  lcd.drawText(120, 21, "percent: ", 0)
  lcd.drawNumber(lcd.getLastPos() + 32, 21, (thrValue + 1024) / 20.48, PREC2)
end

return{run=run}
```


DIGITAL TELEMETRY RADIO SYSTEM
MENU
PAGE
EXIT
ENT
getvalue() example
rsValue: 551
percent: 53.80
thrValue: -505
percent: 25.34
TARANIS
2.4GHz
ACCST

getVersion()

Return OpenTX version

@status current Introduced in 2.0.0, expanded in 2.1.7

Example

This example also runs in OpenTX versions where the function returned only one value:

```
local function run(event)
  local ver, radio, maj, minor, rev = getVersion()
  print("version: "..ver)
  if radio then print ("radio: "..radio) end
  if maj then print ("maj: "..maj) end
  if minor then print ("minor: "..minor) end
  if rev then print ("rev: "..rev) end
  return 1
end

return {  run=run }
```

Output of the above script in simulator:

```
version: 2.1.7
radio: taranis-simu
maj: 2
minor: 1
rev: 7
```

Parameters

none

Return value

- `string` OpenTX version (ie "2.1.5")
- `multiple` (available since 2.1.7) returns 5 values:
  - (string) OpenTX version (ie "2.1.5")
  - (string) radio version: `taranisx9e` , `taranisplus` or `taranis` . If running in simulator the "-simu" is added

- (number) major version (ie 2 if version 2.1.5)
- (number) minor version (ie 1 if version 2.1.5)
- (number) revison number (ie 5 if version 2.1.5)

killEvents(key)

Stops key state machine.

@status current Introduced in 2.0.0

TODO table of events/masks

Parameters

- `key` (number) key to be killed, can also include event type (only key part is used)

Return value

none

playDuration(duration [, hourFormat])

Play a time value (text to speech)

@status current Introduced in 2.1.0

Parameters

- `duration` (number) number of seconds to play. Only integral part is used.
- `hourFormat` (number):
  - `0 or not present` play format: minutes and seconds.
  - `!= 0` play format: hours, minutes and seconds.

Return value

none

Examples

The one time script below will announce "zero hours 1 minute and 1 second"

```
local function run()
  playDuration(61, 1) -- announce "zero hours 1 minute and 1 second
  return 1
end

return { run=run }
```

playFile(name)

Play a file from the SD card

@status current Introduced in 2.0.0, changed in 2.1.0

Parameters

- `path` (string) full path to wav file (i.e. “/SOUNDS/en/system/tada.wav”) Introduced in 2.1.0: If you use a relative path, the current language is appended to the path (example: for English language: `/SOUNDS/en` is appended)

Return value

none

Examples

Example telemetry script

```
local eleid

local function init()
  local fieldinfo = getFieldInfo('ele')
  if fieldinfo then
    eleid = fieldinfo.id
  else
    eleid = -1
  end
end

local function run(e)
  lcd.clear()
  lcd.drawText(1,1,"playFile() example",0)
  local eleVal = getValue(eleid)
  if eleVal > 900 then
    lcd.drawText(1,11,"Whoa - easy there cowboy", 0)
    playFile("horn.wav")
  else
    lcd.drawText(1,11,"eleVal: " .. eleVal, 0)
  end
end

return {init=init, run=run}
```

playNumber(value, unit [, attributes])

Play a numerical value (text to speech)

@status current Introduced in 2.0.0

OpenTX 2.0:

Unit	Sound	File (.wav)	Automatic conversion rules
0	---	--- (no unit played)	
1	Volts	116	
2	Amps	118	
3	Meters per Second	120	
4	*missing file*	122	
5	Kilometers per Hour / Miles per Hour	124 / 142	Input value is KPH
6	Meters / Feet	126 / 140	Input value is meters
7	Degrees	128	Input value is celsius, converted to Fahrenheit for Imperial
8	Percent	130	
9	Milliamps	132	
10	Milliamp Hours	134	
11	Watts	136	
12	DB	138	
13	Feet	140	
14	Kilometers per Hour / Miles per Hour	124 / 142	Input value is in Knots, converted to KPH or MPH
15	Hours	144	
16	Minutes	146	
17	Seconds	148	
18	RPM	150	
19	Gee	152	
20	Degrees	128	

OpenTX 2.1:

2.1 Unit	Sound	Sound File (.wav)
0	---	--- (no unit played)
1	Volts	116
2	Amps	118
3	Milliamps	120
4	Knots	122
5	Meters per Second	124
6	Feet per Second	126
7	Kilometers per Hour	128
8	Miles per Hour	130
9	Meters	132
10	Feet	134
11	Degrees Celsius	136
12	Degrees Fahrenheit	138
13	Percent	140
14	Milliamp Hours	142
15	Watts	144
16	DB	146
17	RPM	148
18	Gee	150
19	Degrees	152
20	Milliliters	154
21	Fluid Ounces	156
22	Hours	158
23	Minutes	160
24	Seconds	162

Parameters

- `value` (number) number to play. Value is interpreted as integer.
- `unit` (number) unit identifier (see table todo)

- `attributes` (unsigned number) possible values:
  - `0 or not present` plays integral part of the number (for a number 123 it plays 123)
  - `PREC1` plays a number with one decimal place (for a number 123 it plays 12.3)
  - `PREC2` plays a number with two decimal places (for a number 123 it plays 1.23)

Return value

none

Notice

2.0 Only - automatic conversion of units for distance, speed, and temperature.

Examples

Example mix script

```
local nbr = 0
local unit = 0
local prec = 0
local lastnbr = 0
local lastunit = 0
local lastprec = 0
local lasttime = 0

local input =
    {
        { "innbr", SOURCE},
        { "inprec", SOURCE},
        { "toggle", SOURCE}
    }

local output = {"nbr", "prec", "unit"}

local function run(innbr, inprec, toggle)
  local change = false
  local advance = false
  local timenow = getTime()

  nbr = innbr -- will range from - 1024 thru + 1024
  prec = math.floor((inprec + 1024) * (2 / 2014)) -- force range to 0 thru 2

  if (toggle > 0) then
    change = true
    advance = true
  end
```

```
  if math.abs(lastnbr - nbr) > 10 then
    change = true
  end

  if not (lastprec == prec) then
    change = true
  end

  if change and ((timenow - lasttime) > 200) then
    lasttime = timenow
    lastnbr = nbr
    if advance then
      lastunit = (lastunit + 1) % 31
    end
    lastprec = prec
    if (lastprec == 0) then
      playNumber(lastnbr, lastunit, 0)
    elseif (lastprec == 1) then
      playNumber(lastnbr, lastunit, PREC1)
    else
      playNumber(lastnbr, lastunit, PREC2)
    end
  end
  return lastnbr * 10.24, lastprec * 10.24, lastunit * 10.24
end

return {run=run, input=input, output=output}
```

playTone(frequency, duration, pause [, flags [, freqIncr]])

Play a tone

@status current Introduced in 2.1.0

Parameters

- `frequency` (number) tone frequency in Hz (from 150 to 15000)
- `duration` (number) length of the tone in milliseconds
- `pause` (number) length of the silence after the tone in milliseconds
- `flags` (number):
  - `0 or not present` play with normal priority.
  - `PLAY_BACKGROUND` play in background (built in vario function uses this context)
  - `PLAY_NOW` play immediately
- `freqIncr` (number) positive number increases the tone pitch (frequency with time), negative number decreases it. The frequency changes every 10 milliseconds, the change is `freqIncr * 10Hz`. The valid range is from -127 to 127.

Return value

none

popupInput(title, event, input, min, max)

Raises a pop-up on screen that allows uses input

@status current Introduced in 2.0.0

Parameters

- `title` (string) text to display
- `event` (number) the event variable that is passed in from the Run function (key pressed)
- `input` (number) value that can be adjusted by the +/- keys
- `min` (number) min value that input can reach (by pressing the - key)
- `max` (number) max value that input can reach

Return value

- `number` result of the input adjustment
- `"OK"` user pushed ENT key
- `"CANCEL"` user pushed EXIT key

Notice

Use only from stand-alone and telemetry scripts.

Model Functions

model.defaultInputs()

Set all inputs to defaults

@status current Introduced in 2.0.0

Parameters

none

Return value

none

model.deleteInput(input, line)

Delete line from specified input

@status current Introduced in 2.0.0

Parameters

- `input` (unsigned number) input number (use 0 for Input1)
- `line` (unsigned number) input line (use 0 for first line)

Return value

none

model.deleteInputs()

Delete all Inputs

@status current Introduced in 2.0.0

Parameters

none

Return value

none

model.deleteMix(channel, line)

Delete mixer line from specified Channel

@status current Introduced in 2.0.0

Parameters

- `channel` (unsigned number) channel number (use 0 for CH1)
- `line` (unsigned number) mix number (use 0 for first line(mix))

Return value

none

model.deleteMixes()

Remove all mixers

@status current Introduced in 2.0.0

Parameters

none

Return value

none

model.getCurve(curve)

Get Curve parameters

@status current Introduced in 2.0.12

Parameters

- `curve` (unsigned number) curve number (use 0 for Curve1)

Return value

- `nil` requested curve does not exist
- `table` curve data:
  - `name` (string) name
  - `type` (number) type
  - `smooth` (boolean) smooth
  - `points` (number) number of points
  - `y` (table) table of Y values:
    - `key` is point number (zero based)
    - `value` is y value
  - `x` (table) **only included for custom curve type**:
    - `key` is point number (zero based)
    - `value` is x value

model.getCustomFunction(function)

Get Custom Function parameters

@status current Introduced in 2.0.0, TODO rename function

Parameters

- `function` (unsigned number) custom function number (use 0 for CF1)

Return value

- `nil` requested custom function does not exist
- `table` custom function data:
  - `switch` (number) switch index
  - `func` (number) function index
  - `name` (string) Name of track to play (only returned only returned if action is play track, sound or script)
  - `value` (number) value (only returned only returned if action is **not** play track, sound or script)
  - `mode` (number) mode (only returned only returned if action is **not** play track, sound or script)
  - `param` (number) parameter (only returned only returned if action is **not** play track, sound or script)
  - `active` (number) 0 = disabled, 1 = enabled

model.getGlobalVariable(index [, flight_mode])

Return current global variable value

Example:

```
-- get GV3 (index = 2) from Flight mode 0 (FM0)
val = model.getGlobalVariable(2, 0)
```

Parameters

- `index` zero based global variable index, use 0 for GV1, 8 for GV9
- `flight_mode` Flight mode number (0 = FM0, 8 = FM8)

Return value

- `nil` requested global variable does not exist
- `number` current value of global variable

Notice

a simple warning or notice

model.getInfo()

Get current Model information

@status current Introduced in 2.0.6, changed in TODO

Parameters

none

Return value

- `table` model information:
  - `name` (string) model name
  - `bitmap` (string) bitmap name

model.getInput(input, line)

Return input data for given input and line number

@status current Introduced in 2.0.0, `switch` added in TODO

Parameters

- `input` (unsigned number) input number (use 0 for Input1)
- `line` (unsigned number) input line (use 0 for first line)

Return value

- `nil` requested input or line does not exist
- `table` input data:
  - `name` (string) input line name
  - `source` (number) input source index
  - `weight` (number) input weight
  - `offset` (number) input offset
  - `switch` (number) input switch index

model.getInputsCount(input)

Return number of lines for given input

@status current Introduced in 2.0.0

Parameters

- `input` (unsigned number) input number (use 0 for Input1)

Return value

- `number` number of configured lines for given input

model.getLogicalSwitch(switch)

Get Logical Switch parameters

@status current Introduced in 2.0.0

Parameters

- `switch` (unsigned number) logical switch number (use 0 for LS1)

Return value

- `nil` requested logical switch does not exist
- `table` logical switch data:
  - `func` (number) function index
  - `v1` (number) V1 value (index)
  - `v2` (number) V2 value (index or value)
  - `v3` (number) V3 value (index or value)
  - `and` (number) AND switch index
  - `delay` (number) delay (time in 1/10 s)
  - `duration` (number) duration (time in 1/10 s)

model.getMix(channel, line)

Get configuration for specified Mix

@status current Introduced in 2.0.0, parameters below `multiplex` added in 2.0.13

Parameters

- `channel` (unsigned number) channel number (use 0 for CH1)
- `line` (unsigned number) mix number (use 0 for first line(mix))

Return value

- `nil` requested channel or line does not exist
- `table` mix data:
  - `name` (string) mix line name
  - `source` (number) source index
  - `weight` (number) weight (1024 == 100%) value or GVAR1..9 = 4096..4011, -GVAR1..9 = 4095..4087
  - `offset` (number) offset value or GVAR1..9 = 4096..4011, -GVAR1..9 = 4095..4087
  - `switch` (number) switch index
  - `multiplex` (number) multiplex (0 = ADD, 1 = MULTIPLY, 2 = REPLACE)
  - `curveType` (number) curve type (function, expo, custom curve)
  - `curveValue` (number) curve index
  - `flightModes` (number) bit-mask of active flight modes
  - `carryTrim` (boolean) carry trim
  - `mixWarn` (number) warning (0 = off, 1 = 1 beep, .. 3 = 3 beeps)
  - `delayUp` (number) delay up (time in 1/10 s)
  - `delayDown` (number) delay down
  - `speedUp` (number) speed up
  - `speedDown` (number) speed down

model.getMixesCount(channel)

Get the number of Mixer lines that the specified Channel has

@status current Introduced in 2.0.0

Parameters

- `channel` (unsigned number) channel number (use 0 for CH1)

Return value

- `number` number of mixes for requested channel

model.getModule(index)

Get RF module parameters

@status current Introduced in TODO

Parameters

- `index` (number) module index (0 for internal, 1 for external)

Return value

- `nil` requested module does not exist
- `table` module parameters:
  - `rfProtocol` (number) protocol index
  - `modelId` (number) receiver number
  - `firstChannel` (number) start channel (0 is CH1)
  - `channelsCount` (number) number of channels sent to module

model.getOutput(index)

Get servo parameters

@status current Introduced in 2.0.0

Parameters

- `index` (unsigned number) output number (use 0 for CH1)

Return value

- `nil` requested output does not exist
- `table` output parameters:
  - `name` (string) name
  - `min` (number) Minimum % * 10
  - `max` (number) Maximum % * 10
  - `offset` (number) Subtrim * 10
  - `ppmCenter` (number) offset from PPM Center. 0 = 1500
  - `symetrical` (number) linear Subtrim 0 = Off, 1 = On
  - `revert` (number) irection 0 = ---, 1 = INV
  - `curve`
    - (number) Curve number (0 for Curve1)
    - or `nil` if no curve set

model.getTimer(timer)

Get model timer parameters

@status current Introduced in 2.0.0

Parameters

- `timer` (number) timer index (0 for Timer 1)

Return value

- `nil` requested timer does not exist
- `table` timer parameters:
  - `mode` (number) timer trigger source: off, abs, stk, stk%, sw/!sw, !m_sw/!m_sw
  - `start` (number) start value [seconds], 0 for up timer, 0> down timer
  - `value` (number) current value [seconds]
  - `countdownBeep` (number) countdown beep (0 = silent, 1 = beeps, 2 = voice)
  - `minuteBeep` (boolean) minute beep
  - `persistent` (number) persistent timer

model.insertInput(input, line, value)

Insert an Input at specified line

@status current Introduced in 2.0.0, `switch` added in TODO

Parameters

- `input` (unsigned number) input number (use 0 for Input1)
- `line` (unsigned number) input line (use 0 for first line)
- `value` (table) input data, see model.getInput()

Return value

none

model.insertMix(channel, line, value)

Insert a mixer line into Channel

@status current Introduced in 2.0.0, parameters below `multiplex` added in 2.0.13

Parameters

- `channel` (unsigned number) channel number (use 0 for CH1)
- `line` (unsigned number) mix number (use 0 for first line(mix))
- `value` (table) see model.getMix() for table format

Return value

none

model.resetTimer(timer)

Reset model timer to a startup value

@status current Introduced in TODO

Parameters

- `timer` (number) timer index (0 for Timer 1)

Return value

none

model.setCustomFunction(function, value)

Set Custom Function parameters

@status current Introduced in 2.0.0, TODO rename function

Parameters

- `function` (unsigned number) custom function number (use 0 for CF1)
- `value` (table) custom function parameters, see model.getCustomFunction() for table format

Return value

none

Notice

If a parameter is missing from the value, then that parameter remains unchanged.

model.setGlobalVariable(index, flight_mode, value)

Sets current global variable value. See also model.getGlobalVariable()

Parameters

- `index` zero based global variable index, use 0 for GV1, 8 for GV9
- `flight_mode` Flight mode number (0 = FM0, 8 = FM8)
- `value` new value for global variable. Permitted range is from -1024 to 1024.

Return value

none

Notice

Global variable can only store integer values, any floating point value is converted into integer value by truncating everything behind a floating point.

Examples

Example

this is a sample example

model/setGlobalVariable-example

```
function foo(bar)
  local x = bar * 2
end
```

model.setInfo(value)

Set the current Model information

@status current Introduced in 2.0.6, changed in TODO

Parameters

- `value` model information data, see model.getInfo()

Return value

none

Notice

If a parameter is missing from the value, then that parameter remains unchanged.

model.setLogicalSwitch(switch, value)

Set Logical Switch parameters

@status current Introduced in 2.0.0

Parameters

- `switch` (unsigned number) logical switch number (use 0 for LS1)
- `value` (table) see model.getLogicalSwitch() for table format

Return value

none

Notice

If a parameter is missing from the value, then that parameter remains unchanged.

model.setModule(index, value)

Set RF module parameters

@status current Introduced in TODO

Parameters

- `index` (number) module index (0 for internal, 1 for external)
- `value` module parameters, see model.getModule()

Return value

none

Notice

If a parameter is missing from the value, then that parameter remains unchanged.

model.setOutput(index, value)

Set servo parameters

@status current Introduced in 2.0.0

Parameters

- `index` (unsigned number) channel number (use 0 for CH1)
- `value` (table) servo parameters, see model.getOutput() for table format

Return value

none

Notice

If a parameter is missing from the value, then that parameter remains unchanged.

model.setTimer(timer, value)

Set model timer parameters

@status current Introduced in 2.0.0

Parameters

- `timer` (number) timer index (0 for Timer 1)
- `value` timer parameters, see model.getTimer()

Return value

none

Notice

If a parameter is missing from the value, then that parameter remains unchanged.

Lcd Functions

Lcd Functions Overview

Description

Lcd functions allow scripts to interact with the transmitter display. This access is limited to the 'run' functions of One-Time and Telemetry scripts.

Notes:

The run function is periodically called when the screen is visible. In OpenTX 2.0 each invocation starts with a blank screen (unless lcd.lock() is used). Under OpenTX 2.1 screen state is always persisted across calls to the run function. **Many scripts originally written for OpenTX 2.0 require a call to lcd.clear() at the beginning of their run function in order to display properly under 2.1.**

Many of the lcd functions accept parameters named *flags* and *patterns*. The names and their meanings are described below.

Flags Constants

Name	Description	Version	Notes
0	normal font, default precision for numeric		
DBLSIZE	double size font		
MIDSIZE	mid sized font		
SMLSIZE	small font		
INVERS	inverted display		
BLINK	blinking text		
XXLSIZE	jumbo font	2.0.6	
LEFT	left justify	2.0.6	Only for drawNumber
PREC1	single decimal place		
PREC2	two decimal places		
GREY_DEFAULT	grey fill		
TIMEHOUR	dislay hours		Only for drawTimer

Patterns Constants

Name	Description
FORCE	pixels will be black
ERASE	pixels will be white
DOTTED	lines will appear dotted

lcd.clear()

Clears the LCD screen

@status current Introduced in 2.0.0

Parameters

none

Return value

none

Notice

This function only works in stand-alone and telemetry scripts.

Examples

lcd/clear-example

```
--
--
-- This example demonstrates the lcd.clear() function
--
-- NOTE: Compare the output of the images below
--       lcd.clear() is NOT CALLED automatically in OpenTX 2.1
--

local startTicks
local nowTicks

local function init()
  startTicks = getTime() / 100.0
end

local function background()
  nowTicks = getTime() / 100.0
end

local function run(e)
  background()
  local interval = 10 - math.floor(nowTicks % 10)
  lcd.drawText(1, 1, "clear() example",0)
  lcd.drawText((10 * interval) + 1, 10 , interval, 0)
  if interval == 10 then
    lcd.clear()
  end
end

return{run=run, background=background}
```

clear-example.lua running under OpenTX 2.1

clear-example.lua running under OpenTX 2.0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lcd.drawChannel(x, y, source, flags)

Display a telemetry value at (x,y)

@status current Introduced in 2.0.6, changed in 2.1.0 (only telemetry sources are valid)

Parameters

- `x,y` (positive numbers) starting coordinate
- `source` can be a source identifier (number) or a source name (string). See getValue()
- `flags` (unsigned number) drawing flags

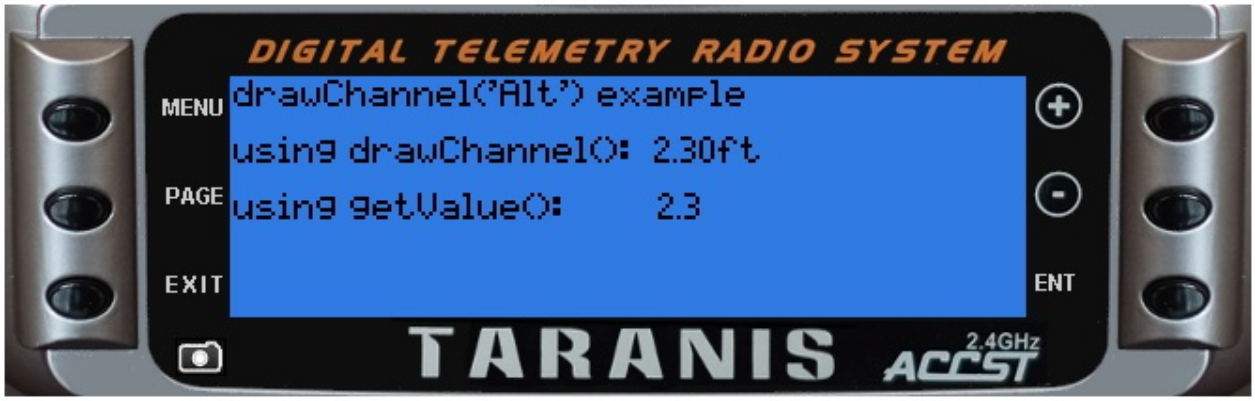
Return value

none

Examples

lcd/drawChannel-example

```
local function run(e)
  lcd.clear()
  lcd.drawText(1, 1, "drawChannel('Alt') example",0)
  lcd.drawText(1, 16, "using drawChannel(): ", 0)
  lcd.drawChannel(lcd.getLastPos()+20, 16 , "Alt", 0)
  lcd.drawText(1, 31, "using getValue(): ", 0)
  lcd.drawText(lcd.getLastPos() + 22, 31, getValue("Alt"), 0)
end

return{run=run}
```



lcd.drawCombobox(x, y, w, list, idx [, flags])

Draws a combo box

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) top left corner position
- `w` (number) width of combo box in pixels
- `list` (table) combo box elements, each element is a string
- `idx` (integer) index of entry to highlight
- `page` (number) page number
- `flags` (unsigned number) drawing flags, the flags can not be combined:
  - `BLINK` combo box is expanded
  - `INVERS` combo box collapsed, text inversed
  - `0 or not present` combo box collapsed, text normal

Return value

none

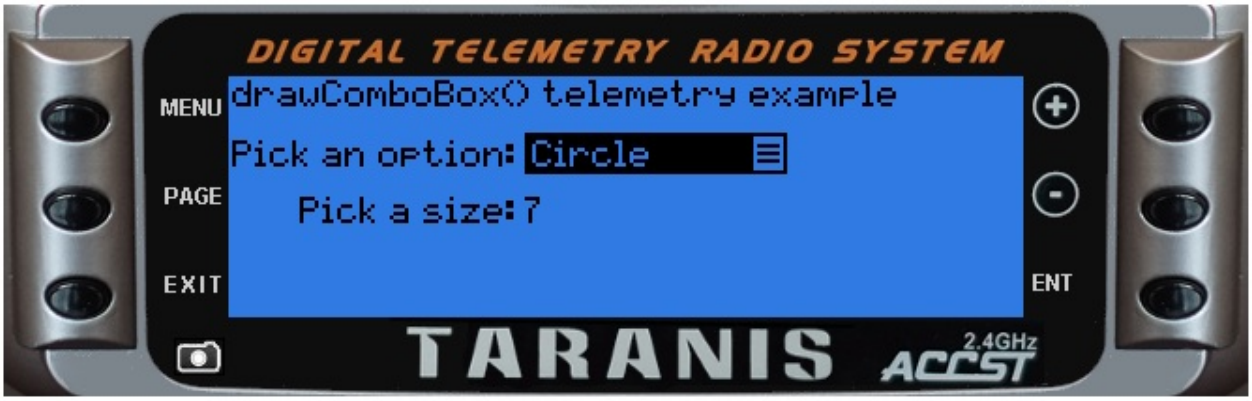
Examples

lcd/drawCombobox-example

```
local comboOptions
local selectedOption
local selectedSize
local editMode
local activeField
local fieldMax

local function valueIncDec(event,value,min,max,step)
    if editMode then
      if event==EVT_PLUS_FIRST or event==EVT_PLUS_REPT then
        if value<=max-step then
          value=value+step
```

```
        end
      elseif event==EVT_MINUS_FIRST or event==EVT_MINUS_REPT then
        if value>=min+step then
          value=value-step
        end
      end
    end
    return value
  end

local function fieldIncDec(event,value,max,force)
    if editMode or force==true then
      if event==EVT_PLUS_FIRST then
        value=value+max
      elseif event==EVT_MINUS_FIRST then
        value=value+max+2
      end
      value=value%(max+1)
    end
    return value
  end

  local function getFieldFlags(p)
    local flg = 0
    if activeField==p then
      flg=INVERS
      if editMode then
        flg=INVERS+BLINK
      end
    end
    return flg
  end

local function init()
  fieldMax = 1
  comboOptions = {"Triangle","Circle","Square"}
  selectedOption = 0
  activeField = 0
  selectedSize = 0
end

local function run(event)
  lcd.clear()
  -- draw from the bottom up so we don't overwrite the combo box if open
  lcd.drawText(19, 32, "Pick a size:", 0)
  lcd.drawText(lcd.getLastPos() + 2, 32, selectedSize, getFieldFlags(1))
  lcd.drawText(1, 1, "drawComboBox() telemetry example",0)
  lcd.drawText(1, 17, "Pick an option:", 0)
  lcd.drawCombobox(lcd.getLastPos() + 2, 15, 70, comboOptions, selectedOption, getFiel
dFlags(0))

  if event == EVT_ENTER_BREAK then
    editMode = not editMode
```

```
  end
  if editMode then
    if activeField == 0 then
      selectedOption = fieldIncDec(event, selectedOption, 2)
    elseif activeField == 1 then
      selectedSize = valueIncDec(event, selectedSize, 0, 10, 1)
    end
  else
    activeField = fieldIncDec(event, activeField, fieldMax, true)
  end
end

return{run=run, init=init}
```



lcd.drawFilledRectangle(x, y, w, h [, flags])

Draws a solid rectangle from top left corner (x,y) of specified width and height

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) top left corner position
- `w` (number) width in pixels
- `h` (number) height in pixels
- `flags` (unsigned number) drawing flags

Return value

none

Examples

lcd/drawFilledRectangle-example

```
local function run()
  lcd.clear()
  lcd.drawText(10,22,"drawFilledRectangle()",DBLSIZE)
  lcd.drawFilledRectangle(5, 5, 103, 50, GREY_DEFAULT)
  lcd.drawFilledRectangle(152, 33, 50, 25, SOLID)
end

return{run=run}
```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lcd.drawGauge(x, y, w, h, fill, maxfill)

Draws a simple gauge that is filled based upon fill value

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) top left corner position
- `w` (number) width in pixels
- `h` (number) height in pixels
- `fill` (number) amount of fill to apply
- `maxfill` (number) total value of fill
- `flags` (unsigned number) drawing flags

Return value

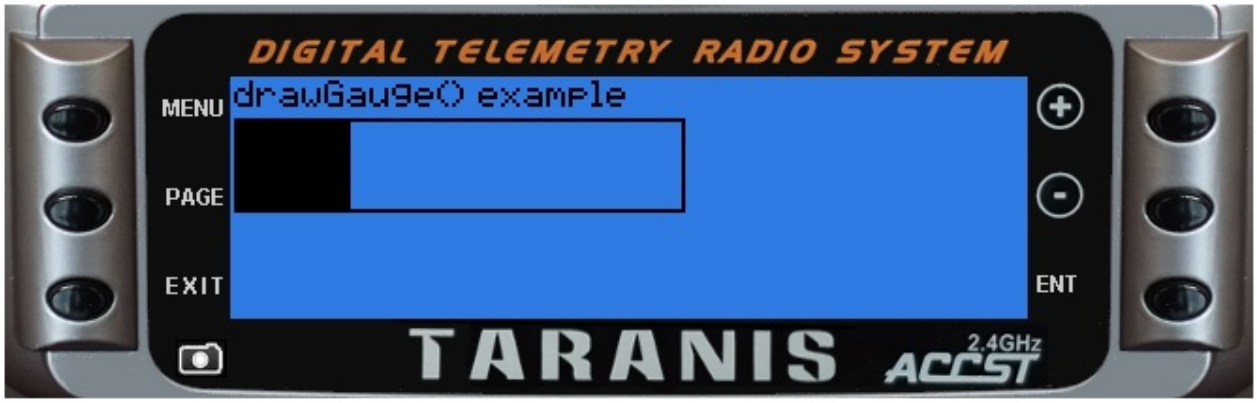
none

Examples

lcd/drawGauge-example

```
local function run(event)
  lcd.clear()
  lcd.drawText(1,1,"drawGauge() example", 0)
  lcd.drawGauge(1, 11, 120, 25, 250, 1000)
end

return{run=run}
```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lcd.drawLine(x1, y1, x2, y2, pattern, flags)

Draws a straight line on LCD

@status current Introduced in 2.0.0

Parameters

- `x1,y1` (positive numbers) starting coordinate
- `x2,y2` (positive numbers) end coordinate
- `pattern` TODO
- `flags` TODO

Return value

none

Notice

If the start or the end of the line is outside the LCD dimensions, then the whole line will not be drawn (starting from OpenTX 2.1.5)

Examples

lcd/drawLine-example

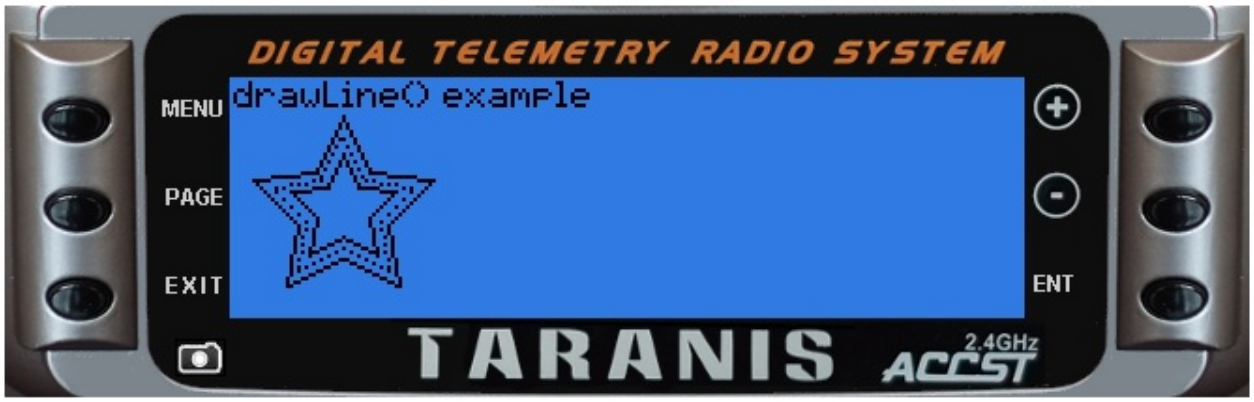
```
local alpha = (2 * math.pi) / 10

local function getPoint(centerX, centerY, radius, point)
  local omega = alpha * point
  local r = radius*(point % 2 + 1)/2
  local X = (r * math.sin(omega)) + centerX
  local Y = (r * math.cos(omega)) + centerY
  return X, Y
end

local function drawStar(centerX, centerY, radius, pattern, flags)
  local point = 10
  local startX, startY = getPoint(centerX, centerY, radius, point)
  for point = 1, 10 do
    local nextX, nextY = getPoint(centerX, centerY, radius, point)
    lcd.drawLine(startX, startY, nextX, nextY, pattern, flags)
    startX = nextX
    startY = nextY
  end
end

local function run(event)
  lcd.clear()
  lcd.drawText(1,1,"drawLine() example", 0)
  drawStar(30, 35, 25, SOLID, FORCE)
  drawStar(30, 35, 20, DOTTED, FORCE)
  drawStar(30, 35, 15, SOLID, FORCE)
end

return{run=run}
```



lcd.drawNumber(x, y, value [, flags])

Display a number at (x,y)

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) starting coordinate
- `value` (number) value to display
- `flags` (unsigned number) drawing flags:
  - `0 or not specified` normal representation
  - `PREC1` display with one decimal place (number 386 is displayed as 38.6)
  - `PREC2` display with tow decimal places (number 386 is displayed as 3.86)
  - other general LCD flag also apply

Return value

none

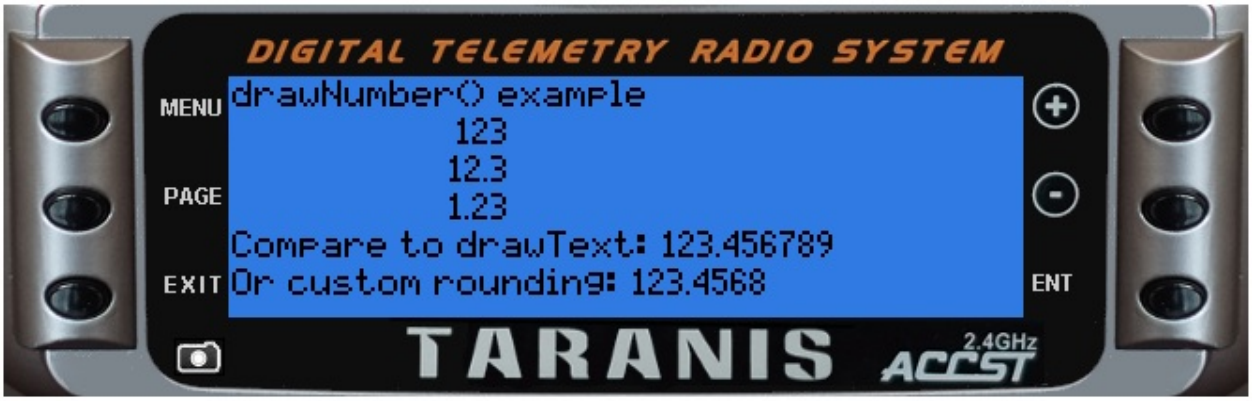
Examples

lcd/drawNumber-example

```
function round(num, decimals)
  local mult = 10^(decimals or 0)
  return math.floor(num * mult + 0.5) / mult
end

local function run(event)
  lcd.clear()
  lcd.drawText(1,1,"drawNumber() example", 0)
  local myNumber = 123.456789
  lcd.drawNumber(75, 11, myNumber, 0)
  lcd.drawNumber(75, 21, myNumber, PREC1)
  lcd.drawNumber(75, 31, myNumber, PREC2)
  lcd.drawText(1, 41, "Compare to drawText: " .. myNumber, 0)
  lcd.drawText(1, 51, "Or custom rounding: " .. round(myNumber, 4), 0)
end

return{run=run}
```



lcd.drawPixmap(x, y, name)

Draws a bitmap at (x,y)

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) starting coordinate
- `name` (string) full path to the bitmap on SD card (i.e. “/BMP/test.bmp”)

Return value

none

Examples

lcd/drawPixmap-example

```
local function run(event)
  lcd.clear()
  lcd.drawText(1,1,"drawPixmap() example", 0)
  lcd.drawPixmap(96, 0, "/bmp/lua.bmp")
end

return{run=run}
```

lcd.drawPoint(x, y)

Draws a single pixel at (x,y) position

@status current Introduced in 2.0.0

Parameters

- `x` (positive number) x position
- `y` (positive number) y position

Return value

none

Notice

Taranis has an LCD display width of 212 pixels and height of 64 pixels. Position (0,0) is at top left. Y axis is negative, top line is 0, bottom line is 63. Drawing on an existing black pixel produces white pixel (TODO check this!)

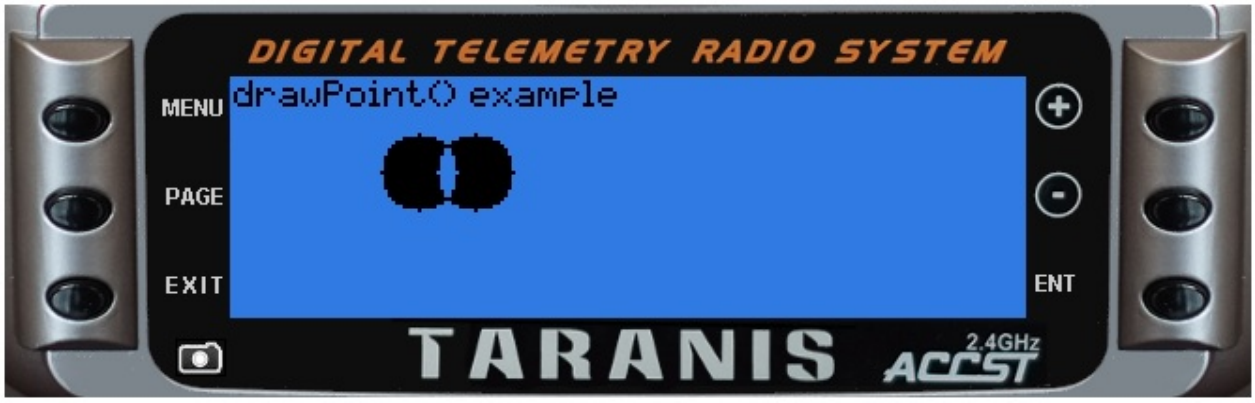
Examples

lcd/drawPoint-example

```
local function circle(xCenter, yCenter, radius)
  local y, x
  for y=-radius, radius do
    for x=-radius, radius do
        if(x*x+y*y <= radius*radius) then
            lcd.drawPoint(xCenter+x, yCenter+y)
        end
    end
  end
end


local function run(event)
  lcd.clear()
  lcd.drawText(1,1,"drawPoint() example", 0)
  circle(50, 25, 10)
  circle(65, 25, 10)
end

return{run=run}
```



lcd.drawRectangle(x, y, w, h [, flags])

Draws a rectangle from top left corner (x,y) of specified width and height

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) top left corner position
- `w` (number) width in pixels
- `h` (number) height in pixels
- `flags` (unsigned number) drawing flags

Return value

none

Examples

lcd/drawRectangle-example

```
local function run()
lcd.clear()
lcd.drawText(10,22,"drawRectangle()",DBLSIZE)
lcd.drawRectangle(5, 5, 150, 50, SOLID)
lcd.drawRectangle(6, 6, 150, 50, GREY_DEFAULT)
lcd.drawRectangle(7, 7, 150, 50, SOLID)
lcd.drawRectangle(8, 8, 150, 50, GREY_DEFAULT)
end

return{run=run}
```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lcd.drawScreenTitle(title, page, pages)

Draws a title bar

@status current Introduced in 2.0.0

Parameters

- `title` (string) text for the title
- `page` (number) page number
- `pages` (number) total number of pages. Only used as indicator on the right side of title bar. (i.e. idx=2, cnt=5, display `2/5`)

Return value

none

Examples

lcd/drawScreenTitle-example

```
local function run(event)
  lcd.clear()
  lcd.drawText(20, 20,"drawScreenTitle", DBLSIZE + BLINK)
  lcd.drawScreenTitle("This screen has one page", 1, 1)
end

return{run=run}
```

lcd.drawSource(x, y, source [, flags])

Displays the name of the corresponding input as defined by the source at (x,y)

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) starting coordinate
- `source` (number) source index
- `flags` (unsigned number) drawing flags

Return value

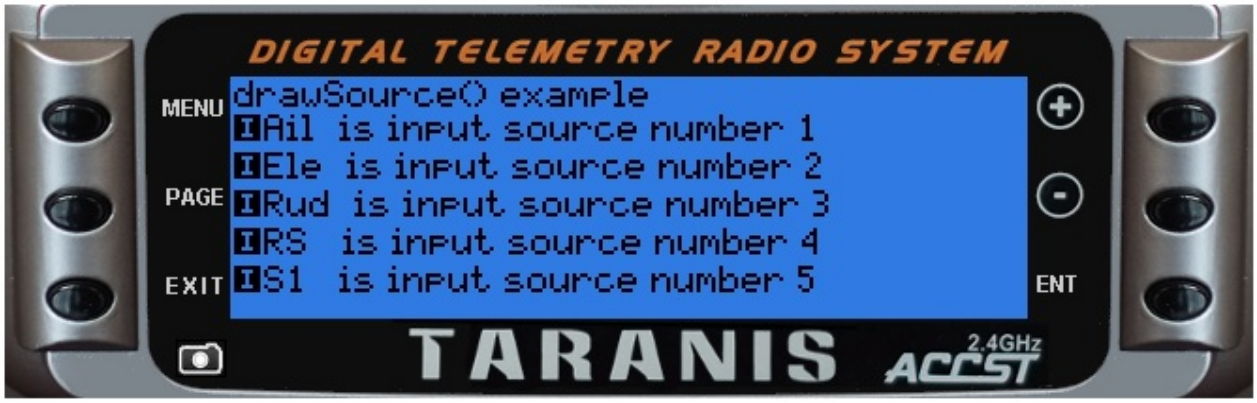
none

Examples

lcd/drawSource-example

```
local function run(event)
  local source
  lcd.clear()
  lcd.drawText(1, 1,"drawSource() example", 0)
  for source = 1, 5 do
   lcd.drawSource(1, source * 10, source, 0)
   lcd.drawText(lcd.getLastPos(), source * 10, " is input source number " .. source)
  end
end

return{run=run}
```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drawSource() example
Ail is input source number 1
Ele is input source number 2
Rud is input source number 3
RS is input source number 4
S1 is input source number 5
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lcd.drawSwitch(x, y, switch, flags)

Draws a text representation of switch at (x,y)

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) starting coordinate
- `switch` (number) number of switch to display, negative number displays negated switch
- `flags` (unsigned number) drawing flags, only SMLSIZE, BLINK and INVERS.

Return value

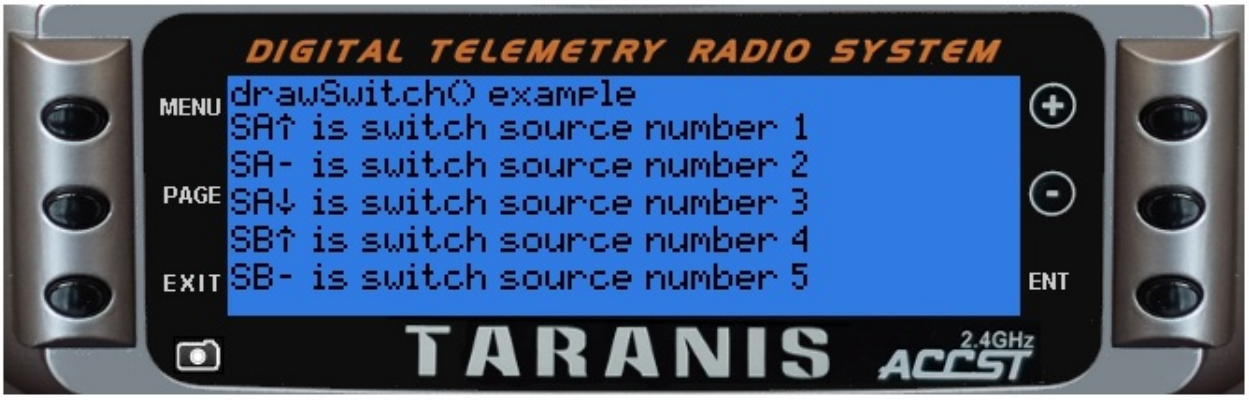
none

Examples

lcd/drawSwitch-example

```
local function run(event)
  local source
  lcd.clear()
  lcd.drawText(1, 1,"drawSwitch() example", 0)
  for source = 1, 5 do
   lcd.drawSwitch(1, source * 10, source, 0)
   lcd.drawText(20, source * 10, " is switch source number " .. source)
  end
end

return{run=run}
```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drawSwitch() example
SA↑ is switch source number 1
SA- is switch source number 2
SA↓ is switch source number 3
SB↑ is switch source number 4
SB- is switch source number 5
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lcd.drawText(x, y, text [, flags])

Draws a text beginning at (x,y)

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) starting coordinate
- `text` (string) text to display
- `flags` (unsigned number) drawing flags. All values can be combined together using the + character. ie BLINK + DBLSIZE. See the Appendix for available characters in each font set.
  - `0 or not specified` normal font
  - `XXLSIZE` jumbo sized font
  - `DBLSIZE` double size font
  - `MIDSIZE` mid sized font
  - `SMLSIZE` small font
  - `INVERS` inverted display
  - `BLINK` blinking text

Return value

none

Examples

lcd/drawText-example

```
local function run(event)
  lcd.clear()
  lcd.drawText(1, 1,"drawText() example", 0)
  lcd.drawText(1, 11,"0 - default", 0)
  lcd.drawText(1, 21,"BLINK", BLINK)
  lcd.drawText(1, 31,"INVERS + BLINK", INVERS + BLINK)
  lcd.drawText(120, 1,"XXLSIZE", DBLSIZE)
  lcd.drawText(120, 21,"MIDSIZE", MIDSIZE)
  lcd.drawText(120, 36,"SMLSIZE", SMLSIZE)
end

return{run=run}
```

lcd.drawTimer(x, y, value [, flags])

Display a value formatted as time at (x,y)

@status current Introduced in 2.0.0

Parameters

- `x,y` (positive numbers) starting coordinate
- `value` (number) time in seconds
- `flags` (unsigned number) drawing flags:
  - `0 or not specified` normal representation (minutes and seconds)
  - `TIMEHOUR` display hours
  - other general LCD flag also apply

Return value

none

Examples

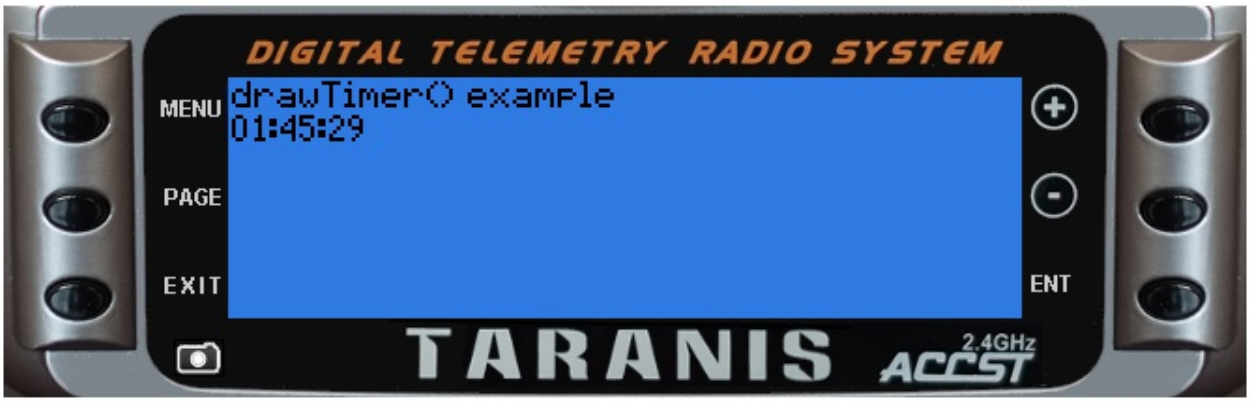
lcd/drawTimer-example

```
local upTime

local function background()
  upTime = getTime() / 100
end

local function run(event)
  background()
  lcd.clear()
  lcd.drawText(1, 1,"drawTimer() example", 0)
  lcd.drawTimer(1, 10, upTime, TIMEHOUR)
end

return{run=run}
```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drawTimer() example
01:45:29
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lcd.getLastPos()

Returns the last x position from previous output

@status current Introduced in 2.0.0

Parameters

none

Return value

- `number` (integer) x position

lcd.lock()

@status depreciated since 2.1

Parameters

none

Return value

none

Notice

This function has no effect in OpenTX 2.1 and will be removed in 2.2

Part IV - Converting OpenTX 2.0 Scripts

The handling of telemetry data is significantly improved in OpenTX 2.1. However, in order to support the additional flexibility of having multiple sensors of the same type, many Lua scripts referencing GPS and Lipo sensor data will require revision.

This section also covers some of the requirements for scripts that are necessary for them to function properly under both OpenTX 2.1 and OpenTX 2.0.

General Issues in converting scripts written for OpenTX 2.0

Deprecated Functions

lcd.Lock() is deprecated, will be obsolete in 2.2. Lua scripts must now explicitly call lcd.Clear() and re-draw the whole display if necessary.

> TODO: research killEvents() and use of keys in telemetry scripts

Obsolete Telemetry Field Names

OpenTX 2.1 now provides more flexibility in the number and type of supported remote sensors. As a result, several field name constants are obsolete and need to be modified in scripts originally written for OpenTX 2.0.

GPS field names are covered in Handling GPS Sensor Data

Lipo voltage field names (LVSS) are covered in Handling Lipo Sensor Data

Maintaining compatibility with OpenTX 2.0

Automatic invocation of the background function - Beginning in OpenTX 2.1 the background() function is called automatically prior to each invocation of the run() function. Under 2.0 you must explicitly call your background function within your run function.

Handling GPS Sensor data

Overview

With OpenTx 2.1 it is possible to have multiple GPS sensors, each with their own set of telemetry values which may have user-assigned names.

Value names are case sensitive and may include some or all of the following:

- GPS (latitude and longitude as a lua table containing [lat] and [lng])
- GSpd (speed in knots)
- GAlt (altitude in meters)
- Date (gps date converted to local time as a lua table containing [year] [mon] [day] [hour] [min] [sec])
- Hdg (heading in degrees true)

This example demonstrates getting latitude and longitude from a sensor with the default name of 'GPS'

```
local gpsValue = "unknown"

local function rnd(v,d)
    if d then
     return math.floor((v*10^d)+0.5)/(10^d)
    else
     return math.floor(v+0.5)
    end
end

local function getTelemetryId(name)
    field = getFieldInfo(name)
    if field then
      return field.id
    else
      return -1
    end
end

local function init()
  gpsId = getTelemetryId("GPS")
end

local function background()
  gpsLatLon = getValue(gpsId)
  if (type(gpsLatLon) == "table") then
    gpsValue = rnd(gpsLatLon["lat"],4) .. ", " .. rnd(gpsLatLon["lon"],4)
  else
    gpsValue = "not currently available"
  end
end

local function run(e)
  lcd.clear()
  background() -- update current GPS position
  lcd.drawText(1,1,"OpenTX 2.1 GPS example",0)
  lcd.drawText(1,11,"GPS:", 0)
  lcd.drawText(lcd.getLastPos()+2,11,gpsValue,0)
end

return{init=init,run=run,background=background}
```

Handling Lipo Sensor Data

With OpenTx 2.1 it is possible to have multiple Lipo sensors, each with a user-assigned name. The call to getValue() returns a table with the current voltage of each of the cells it is monitoring.

This example demonstrates getting Lipo cell voltage from a sensor with the default name of 'Cels'

Example:

```
local cellValue = "unknown"
local cellResult = nil
local cellID = nil

local function getTelemetryId(name)
    field = getFieldInfo(name)
    if field then
      return field.id
    else
      return -1
    end
end

local function init()
  cellId = getTelemetryId("Cels")
end

local function background()
  cellResult = getValue(cellId)
  if (type(cellResult) == "table") then
    cellValue = ""
    for i, v in ipairs(cellResult) do
      cellValue = cellValue .. i .. ": " .. v .. " "
    end
  else
    cellValue = "telemetry not available"
  end
end

local function run(e)
  background()
  lcd.clear()
  lcd.drawText(1,1,"OpenTX 2.1 cell voltage example",0)
  lcd.drawText(1,11,"Cels:", 0)
  lcd.drawText(lcd.getLastPos()+2,11,cellValue,0)
end

return{init=init,run=run,background=background}
```

Part V - Advanced Topics

The advanced topics section covers file i/o, data sharing, and debugging techniques

Lua data sharing across scripts

Overview:

OpenTX considers all function, mix, and telemetry scripts to be 'permanent' scripts that share the same runtime environment. They are typically loaded at power up or when a new model is selected. However, they are also reinitialized when a script is added or removed during model editing.

Lua scoping rules:

Any variable or function not declared local is implicitly global. Care must be taken to avoid unintentional global declarations, and ensure that the globals you intentionally declare have unique names to avoid conflicts with scripts written by others.

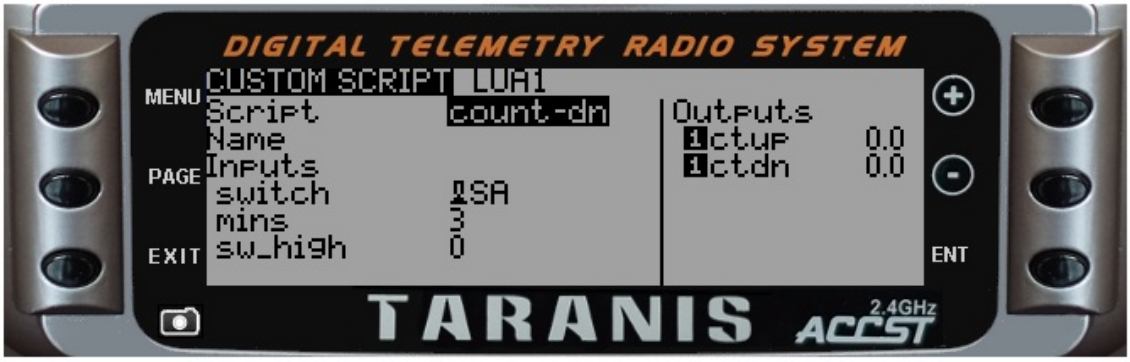
Example:

This example consists of three scripts

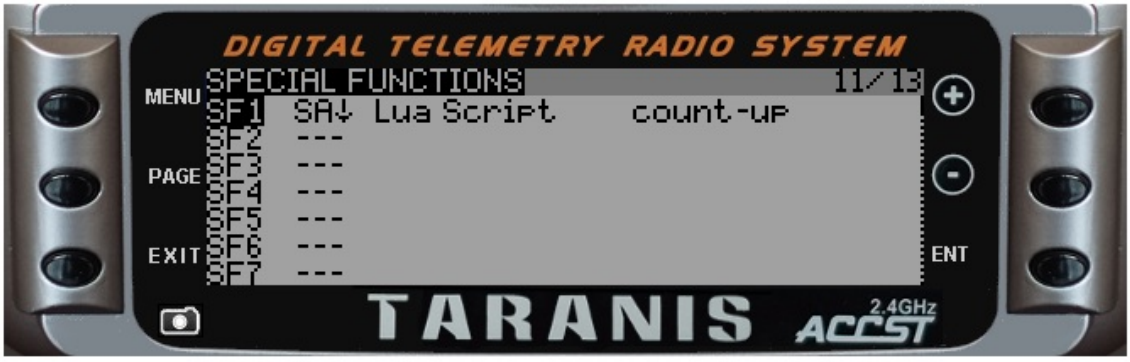
- **count-dn.lua** - this is a mix script than can be run stand alone to announce time remaining based on a user-defined switch and duration. It updates two global variables (gCountUp and gCountDown). It also creates output values (ctup and ctdn) which are for demonstration purposes only.
- **count-up.lua** - this is an optional function script which will do count up announcements based on harded coded values.
- **shocount.lua** - this is an optional telemetry script which simply shows the current values of the gCountUp and gCountDown variables.

Installation:

- count-dn.lua
  - copy to /SCRIPTS/MIXES
  - configure on the transmitter CUSTOM SCRIPT page
    - suggested switch = "SA"
    - suggested mins = 3
    - suggested sw_high = 0
  - screen image:



- count-up.lua
  - copy to /SCRIPTS/FUNCTIONS
  - configure on the transmitter SPECIAL FUNCTIONS page
    - suggested switch SA(down)
  - screen image:



- shocount.lua
  - copy to /SCRIPTS/TELEMETRY
  - configure on the transmitter TELEMETRY page
  - screen image:

Script sources:

count-dn.lua

```
-- these globals can be referenced in function and telemetry scripts
gCountUp = 0
gCountDown = 0
```

```
local target
local running = false
local complete = false
local announcements = { 720, 660, 600, 540, 480, 420, 360, 300, 240, 180, 120, 105, 90
, 75, 60, 55, 50, 45, 40, 35, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17,
16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0}
local annIndex -- index into the announcements table (1 based)
local minUnit -- used by playNumber() for unit announcement

local input =
    {
        { "switch", SOURCE},         -- switch used to activate count down
        { "mins", VALUE, 1, 12, 2 },     -- minutes to count down
        { "sw_high", VALUE, 0, 1, 1 } -- 0 = active when low, otherwise active when hi
gh
    }

local output = {"ctup", "ctdn" }

local function init()
  local version = getVersion()
  if version < "2.1" then
    minUnit = 16 -- we are running OpenTX 2.0
  else
    minUnit = 23
  end
end

local function countdownIsRunning(switch, sw_high)
  -- evaluate switch - return true if we should be counting down
  if (sw_high > 0) then
    return (switch > -1000)
  else
    return (switch < 1000)
  end
end

local function run(switch, mins, sw_high)
  local timenow = getTime() -- 10ms tick count
  local minutes
  local seconds

  if (not countdownIsRunning(switch, sw_high)) then
      running = false
      complete = false
      return 0, 0 -- ***** NOTE: early exit *****
  end

  if (complete) then
    return 0, 0 -- must reset the switch before we go again
  end
```

```
  if (not running) then
    running = true
    target = timenow + ((mins * 60) * 100)
    annIndex = 1
  end

  gCountDown = math.floor(((target - timenow) / 100) + .7) --  + is adj. to for announ
cement lag
  gCountUp = (mins * 60) - gCountDown

  while gCountDown < announcements[annIndex] do
    annIndex = annIndex + 1 -- catch up
  end

  if gCountDown == announcements[annIndex] then
    minutes = math.floor(gCountDown / 60)
    seconds = gCountDown % 60
    if minutes > 0 then
      playNumber(minutes, minUnit, 0)
    end
    if seconds > 0 then
      playNumber(seconds, 0, 0)
    end
    annIndex = annIndex + 1
  end

  if gCountDown <= 0 then
    playNumber(0,0,0)
    running = false
    gCountDown = 0
    complete = true
  end

  return gCountUp * 10.24, gCountDown * 10.24
end

return { input=input, output=output, init=init, run=run }
```

count-up.lua

```
gCountUp = 0

local min = 5
local max = 30
local last = 0
local announcements = { 5, 10, 15, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 }
local annIndex = 1

local function run(e)
  if not (gCountUp == last) then
    last = gCountUp
    for key, value in pairs(announcements) do
        if value == last then
          playNumber(last, 0, 0)
        end
    end
  end
end

return{run=run}
```

shocount.lua

```
-- these globals can be referenced in mix, function, and telemetry scripts
gCountUp = 0
gCountDown = 0

local function run(e)
  lcd.clear()
  lcd.drawText(1,1,"OpenTx Lua Data Sharing",0)

  lcd.drawText(1,11,"gCountUp:", 0)
  lcd.drawText(lcd.getLastPos()+2,11,gCountUp,0)
  lcd.drawText(1, 21, "gCountDown:", 0)
  lcd.drawText(lcd.getLastPos()+2,21,gCountDown,0)
end

return{run=run}
```

Debugging techniques