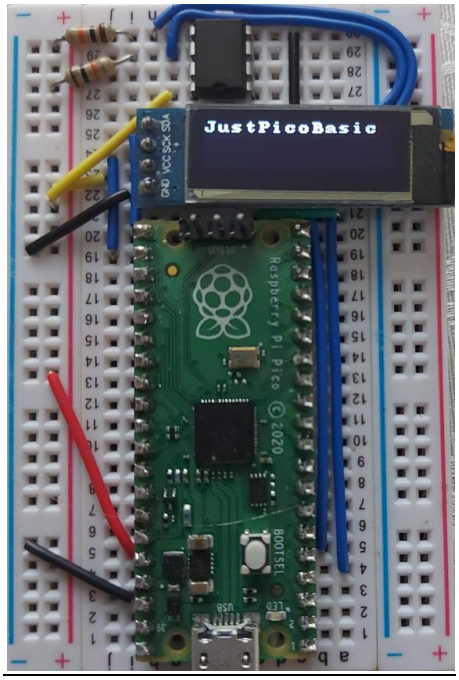
# ***#JustPicoBasic manual***

*The best way to see how it works is to run a few examples available at:*
*https://github.com/bgolab/JustBasic/tree/main/examples*

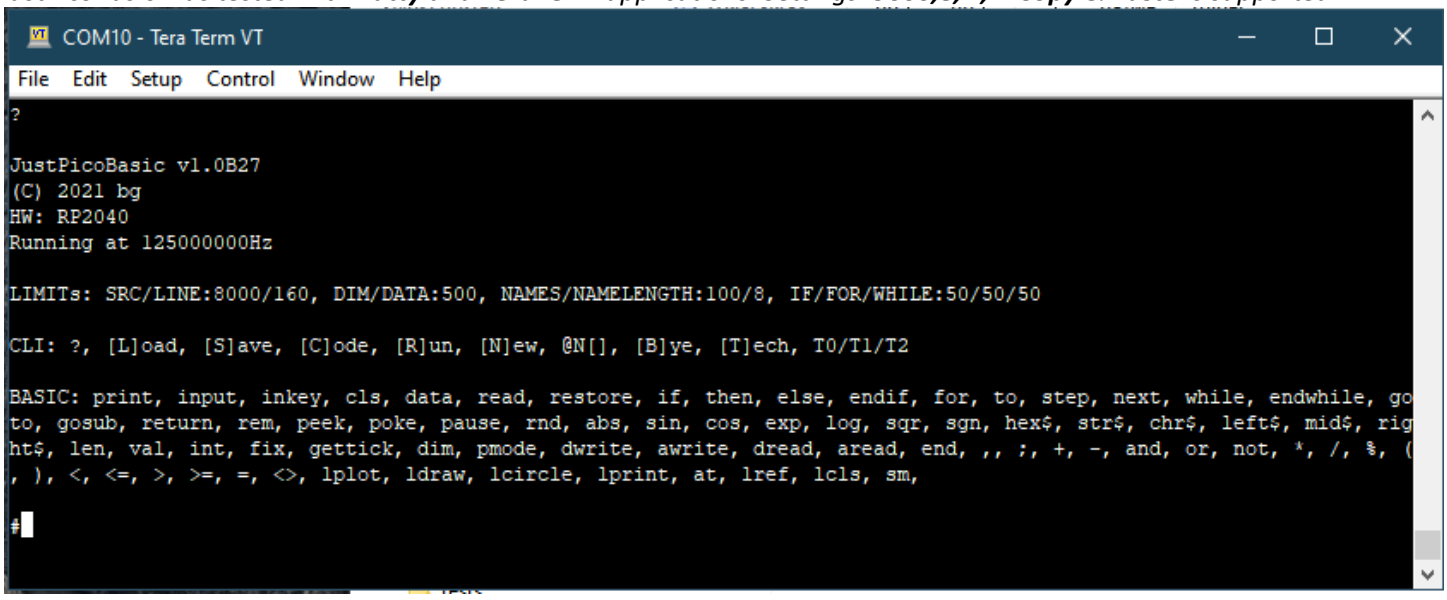
## ***Wiring***

*Hardware components:* ***RPI PICO, OLED 0.91" I2C, EEPROM 24c64 I2C, 2x resistors 10kohm***




## ***Terminal emulator***

*JustPicoBasic was tested with* ***Putty*** *and* ***TeraTerm*** *applications. Settings:* ***9600,8,N,1****.* ***Copy & Paste*** *is supported.*




## ***Get started***

*Power the PICO through the USB. Start the terminal emulator.*
*Drag & Drop the current UF2 file (e.g. JustBasic-1.0b30.uf2) into the PICO emulated disk. The JustPicoBasic will boot.*
*Enter '**?**' (the question mark) and press ENTER. You will see available commands (CLI & BASIC commands).*
*Enter the following program:*

```
pmode 25,1
for k=1 to 5
```

```
        dwrite 25,1
        pause 500
        dwrite 25,0
        pause 500
next k
end
```

*Use enter '**c**' to show the code. Use '**r**' to run the code. The built-in LED will blink.'**n**' clears the program memory.*
*You can use **@N** (e.g. @0) to delete Nth line or **@N <code>** (@0 print 1) to insert the line of code.*
*You can freely format the code – can put many commands in single line, etc. Capital and small letters accepted for keyword (i.e. 'CLS' and 'cls' are the same). Names recognizes small and capital letters (i.e. 'as' is different than 'AS')*

***Program structure***

| **Program Structure** | **Description/Comments** | **Example** |
|---|---|---|
| code<br>gosub subr1<br>end<br>subr1:<br>[subr1 code]<br>return | Command 'end' has to follow the last line of the main code. Subroutines have to follow the 'end'. | print "Hi!"<br>gosub callme<br>end<br>callme:<br>  print "Hi!"<br>return |

***System commands***

| **Command** | **Description/Comments** | **Example** |
|---|---|---|
| ESC key | Break the program while Running or prevent from Loading. | |
| ? | Shows info about the VM (ver, available commands) | |
| c | Show code ('SM LN 0' prevents from displaying line numbers) | |
| r<br>r <code> | Run – run code from SRAM memory<br>Run - run single line of code NOT stored in memory (ad-hoc) | r n=2 data 2, 3 s=0 for i=1 to n read a s=s+a<br>next i print "s=", s end |
| n | New – clear VM memory and code | |
| b | Bye: PICO – reboot VM in disk mode, Windows - exist | |
| l<br>s | l - Load program from EEPROM (auto.bas)<br>s - Save program to EEPROM (auto.bas) | |
| ee<br>ed | ee - EEPROM erase – to decide if required, now disabled<br>ed - EEPROM dump – show EEPROM content | |
| is | I2C scan – show I2C devices on both I2C buses | |
| t0\|t1\|t2 | **Program Flow Tracing**:<br>t0 - Disable Tracing; t1 - Stepping Mode; t2 - Run with Tracing | T1\|T2 - enable particular tracing mode<br>R – run program in T1 or T2 mode |
| @N<br>@N <code> | **Pico Editor.** Normally new code is appended at the end;<br>@N delete Nth line; @N <code> insert <code> before Nth line | @3 – removes 3rd line of code<br>@4 CLS – inserts 'CLS' before line 4 |

***The BASIC language***

| **Command** | **Description/Comments** | **Example** |
|---|---|---|
| SM <entity> 1\|0 | System Mode command for system entities configuration. Entities:<br>ESC (default=enabled) – enable / disable ESC key check (disable to boost performance)<br>LN (default=enabled) – enable / disable line numbering for 'c' command<br>OLED (default=disabled) – enable OLED hw (cannot be disabled now)<br>NOTE: OLED auto-detection is supported now so 'SM OLED 1' is not longer required | SM ESC 0<br>SM OLED 1<br>SM LN 0 |
| REM | Comment | REM MyFunc |
| CLS | Clear Screen | CLS |

***VARIABLES & EXPRESSIONS***
***Suffix-based (suffix #, $, OR no suffic to declare variable type) varname and array syntax***

*-variable name: up to 8chars letter&digits starting w/ a letter (digits, '#", '$', '_', ':' accepted)*
*-expr(arithmetic expression): combination of INT/FLOAT and ops/brackets( +, -, *, /, %,(, )) and INT/FLOAT vars;*
*-sexpr(string expression): combination of string, string functions (with suffix $) and string vars (with suffix $) and '+' op*
*-variable type differentiation through the suffix (no suffix – integer, '#' suffix – float, '$' suffix – string*
*-array index counts from 0 (for: DIM a(3) available array elements are referred by a(0), a(1), a(2)*
*-string arrays must have 2-dimentions e.g. DIM a$(2,5) – 2 strings, maximum length of a string is 5 characters; string arrays are always referred through single index a$(0), a$(1) for DIM a$(2,5) array*

| **Command** | **Description/Comments** | **Example** |
|---|---|---|
| var=expr | INT var, name=expr, 1st-reference creates var(value=0); | sy=2*abs(-15) + a*20 |
| var#=expr | FLOAT var (# suffix), name#=expr, 1st-reference creates var w/ value=0 | w#=2*a#+abs(-1.0) |
| var$=sexpr | STR var ($ suffix), name$=sexpr | v$=a$+left$(str$(13),1) |
| DIM var(s1[,s2]), var#(s1[,s2]), var$(s1,s2) | INT/FLOAT/STRING array, 1/2-dimensions; multi-array declaration (array names separated by comma) | DIM a(3), b#(4,4), c$(4,5) |
| var(expr[,expr])=expr | INT: name(item)=expr | a(0)=3 |
| var#(expr[,exp])=expr | FLOAT: name#(item)=expr | b#(0)=2.5 |
| var$(expr)=sexpr | STRING: name$(item)=sexpr | c$(2)="abc" |

***Suffixless varname and array syntax (experimental)***
*-variable needs to be declared (if not declared integer type is assumed), multi-declaration in single command supported*
*-initialization during the declaration phase is not supported yet*
*-array index counts from 0 (for: DIM a(3) available array elements are referred by a(0), a(1), a(2)*
*-string arrays must have 2-dimentions e.g. string a(2,5) – 2 strings, maximum length of a string is 5 characters; string arrays are always referred through single index a(0), a(1) for string a(2,5) array*

| **Command** | **Description/Comments** | **Example** |
|---|---|---|
| integer vname, vname2(s1[,s2])),.. | Declare integer var or 1/2-dimensional array; value=0 set | integer a, b(8,2) b(0,0)=1 |
| float vname, vname2(s1[,s2]),.. | Declare float var or 1/2-dimensional array; value=0 set | float c, b(0,0)=1.0 |
| string vname, vname2(s1,s2),.. | Declare string var or 1/2-dimensional array; value=null set | string b(2,4) a(1)="no" |

***PROGRAM FLOW CONTROL***
*-cond: logical expression e.g. a>5 and b<10*
*-lexpr(logical expression): combination of conditional and logical operators*

| **Command** | **Description/Comments** | **Example** |
|---|---|---|
| FOR v=expr TO expr [STEP expr] [code] NEXT var | if STEP[default=1] is negative var decreases; INT/FLOAT supported; nesting supported | FOR i = 5 TO 1 STEP -1 NEXT I END |
| WHILE lexpr [code] ENDWHILE | INT/FLOAT supported; nesting supported; cond: AND/OR/NOT supported; | a=0 while a<5 print a a=a+1 endwhile end |
| IF lexpr THEN [code] [ELSE] [code] ENDIF | INT/FLOAT supported; nesting supported AND/OR/NOT) supported; | if a>1 and b#>3.4 then print "ok" else print "bad" endif |
| label:<br>GOTO label | Label name starts with a letter, terminated by colon; up to 8 letter & digits( plus '_'); | k=1 again: print k k=k+1<br>if k<5 then goto again: endif |
| GOSUB label | Label must be located after END | gosub task0 end |
| label: RETURN | label: [code] RETURN | task0: print "done" return |
| END | Last instruction. GOSUB labels follows END | |

***INPUT, OUTPUT, DATA***

| **Command** | **Description/Comments** | **Example** |
|---|---|---|
| PRINT expr[, sexpr], [;] | Prints expr, sexpr separated by ','<br>';' to skip NEW LINE | PRINT "6/3=", 6/3 (with NEW LINE)<br>PRINT 1; (w/o NEW LINE because of ';') |
| INPUT var,... | Assign int/float/str values to (array) var | INPUT a(2), d#, n$ print a(2), d#, n$ |
| DATA expr, sexpr; | INT/FLOAT/STR supported | DATA 1.5, 2*a |
| READ a, b#, d$ | Assign DATA specified input to vars | READ v, v#, v(), v#(); |
| RESTORE | Reset data pointer | |

***BUILT-IN FUNCTIONS***

| ***Command*** | ***Description/Comments*** | ***Example*** |
|---|---|---|
| *LEFT$$/RIGHT$/MID$(sexpr),* | *Left$/right$/mid$ - string functions,* | *k$=LEFT$("abc", 2) + "123" i=12 i$=MID$(STR$(i),2,3) PRINT i$* |
| *HEX$/STR$/CHR$(expr)* | *Hex$(expr to hex string), Str$(expr to string), Chr$(expr%256 to ascii e.g. 65 to 'A')* | *PRINT HEX$(NOT(0x0F)) a=65 d$=chr$(a)* |
| *LEN/VAL/ASC(sexpr)* | *Val(string to value); LEN(string length), ASC(ascii code of the 1st char of the string)* | *PRINT VAL("-1234")+1 PRINT ASC("AB")->65* |
| *SIN/COS/SQR/EXP/LOG(expr), SGN/ABS(expr)* | *Math functions* | *PRINT "S:", SQR(5), "E:", EXP(1), "L:", LOG(2.71), "S:",SIN(3.14/6)* |
| *RND(max)* | *Hw-based random generator with von Neuman extractor-whitenizer* | *PRINT "RND: ", RND(1000)* |
| *GETTICK()* | *Tick number* | *a=gettick()* |
| *PAUSE msec* | *Delay (blocking) in msec* | *PAUSE 2*500* |
| *INKEY()* | *Pressed key, OR 0; non-blocking (no-wating)* | |
| *INT/FIX(expr)* | *QBASIC like* | *a=INT(1.1) b=INT(-1.1) c=FIX(1.9) d=FIX(-1.9) PRINT a, ", ", b, ", ", c, ", ", d (1,-2,1,-1)* |
| *AND/OR(expr,expr), NOT(expr)* | | *PRINT AND(0x3,0xF), OR(0x1,0x2), HEX$(NOT(0x0F))* |

***PICO HARDWARE SUPPORT***

| ***Command*** | ***Description/Comments*** | ***Example*** |
|---|---|---|
| *PEEK(addr)*<br>*POKE addr, value* | *Memory read / write; hex supported* | *REM SYSTICK*<br>*SYSTCSR=0xe000e010*<br>*SYSTRVR=0xe000e014*<br>*SYSTCVR=0xe000e018*<br>*poke SYSTCSR, 0*<br>*poke SYSTRVR, 0x1e847*<br>*poke SYSTCSR, 5*<br>*for k=1 to 50*<br>*  print and(peek(SYSTCVR), 0x00FFFFFF)*<br>*  pause 1000*<br>*next k* |
| *PMODE pin, mode* | *mode: 0-IN, 1-OUT, 2-PULLUP, 3-PULLDOWN, 10-ADC, 15-PWM, 20-TSENSOR* | |
| *AREAD(pin)* | *Read analog pin; pins=26-29 – analog pin; pin=100 –temperature virtual pin* | *pmode 26, 10 voltage=aread(26)*<br>*pmode 100, 20 temp= aread(100)* |
| *AWRITE pin, cycles* | *PWM duty=cycles/65535 cycle: 0-65535)* | *pmode 22, 15 awrite 22, 16000* |
| *DREAD(pin)* | *Read digital pin* | *REM explorer buttons: a, b, x, y*<br>*a=12 b=13 x=14 y=15 pmode y, 0 pmode y, 2*<br>*for k=1 to 2 step 0 pause 50 print dread(y) next k* |
| *DWRITE pin, value* | *Write digital pin* | *REM explorer led - pin 25*<br>*pmode 25, 1 dwrite 25,1 pause 3000 dwrite 25,0* |

***GRAPHIC LCD/OLED SUPPORT*** *(currently: OLED0.91 support)*

*NOTE: As of 1.0b31 OLED auto-detection was added - 'SM OLED 1' is not longer required*

| ***Command*** | ***Description/Comments*** | ***Example*** |
|---|---|---|
| *SM OLED 1* | *Enable OLED support* | |
| *LPLOT X, Y* | *Draw point at X, Y* | *for x=0 to 127*<br>*  lplot x,fix(15+15*sin(2*3.14*x/128))*<br>*next x* |

| | | |
|---|---|---|
| | | *lref* |
| *LDRAW X, Y* | *Draw line from the last LPLOT / LDRAW X,Y* | *plot 10,10 ldraw 20,20 lref* |
| *LCIRCLE x, y, r* | *Draw circle at x, y, r* | *lcircle 15, 15, 10* |
| *LPRINT expr, sexpr [AT x,y]* | *Prints expr, sexpr separated by ',';*<br>*AT x, y (default 0,0)* | *lprint "2+2=", 2+2 AT 10,10*<br>*lref* |
| *LCLS* | *Clear Screen* | *lcls* |
| *LREF* | *Refresh LCD (copy mem content to LCD)* | *lref* |