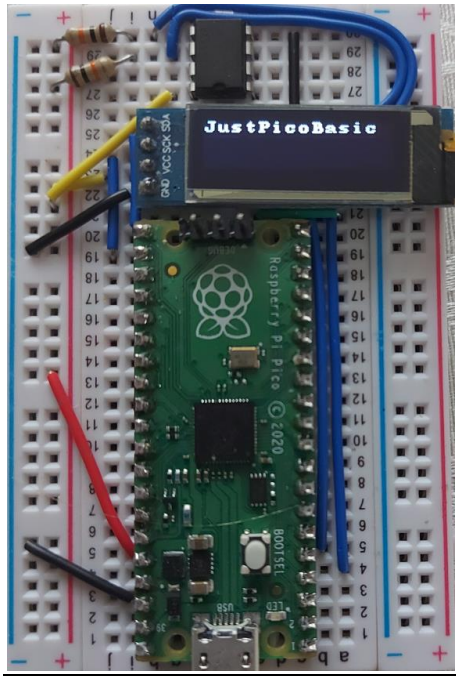
#JustPicoBasic manual

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***



Getting started

Power the PICO through the USB. Start a terminal emulator e.g. ***Putty, TeraTerm****. Use the following settings:* ***9600,8,N,1****. Copy & Paste is supported. Copy the current UF2 file (e.g. JustBasic-1.0b36.uf2) to the PICO disk. The PICO will boot. Enter '****?****' and press ENTER. You will see available SYSTEM & BASIC commands.*

```
COM10 - Tera Term VT
File  Edit  Setup  Control  Window  Help
?

JustPicoBasic v1.0B42
(C) 2021 bg
HW: RP2040

TICKS: 827761

LIMITS: SRC/LINE:8000/160, HEAP/STACK:1000/50, NAMES/LENGTH:100/10, IF/LOOP:50/50

SYSTEM: ?, l[load], s[save], c[code], r[run], n[new], b[bye], @n[], t0-t2

BASIC: integer, float, string, print, input, inkey, cls, data, read, restore, if, then, else, endif, for, to, step, b
reak, next, while, endwhile, goto, gosub, return, rem, abs, sin, cos, exp, log, sqr, sgn, hex$, str$, chr$, asc, left
$, mid$, right$, len, val, int, fix, dim, end, ,, ;, +, -, and, or, not, *, /, %, (, ), <, <=, >, >=, =, <>, ==, !=,
rnd,

HW: peek, poke, pause, gettick, pmode, dwrite, awrite, dread, aread, lplot, ldraw, lcircle, lprint, at, lref, lcls, i
init, ideinit, ireadable, iwriteable, iread, iwrite, uinit, udeinit, ureadable, uwriteable, uread, uwrite, sinit, sde
init, sreadable, swriteable, sread, swrite, ts, sm,

CONST: INPUT, OUTPUT, PULLUP, PULLDOWN, ADC, PWM, TSENSOR, I2C0, I2C1, UART0, UART1, SPI0, SPI1, HIGH, ESC, OLED, TEC
H, LOW, ENABLE, DISABLE,

#
```

Enter an example BASIC program:

```
pmode 25,1
for k=1 to 5
        dwrite 25,1 pause 500
        dwrite 25,0 pause 500
next k
end
```

*Use '**c**' to see the code, '**r**' to run the code. The built-in LED will blink. The '**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 gosub subr1 end subr1: [subr1 code] return	Command 'end' has to follow the last line of the main code. Subroutines have to follow the 'end'.	print "Hi!" gosub callme end callme: print "Hi!" 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, cc	c-show the code w/ line numbers, cc-show the code w/o line numbers	
r	Run – run code from SRAM memory	
r <code>	Run - run single line of code NOT stored in memory (ad-hoc)	r for i=1 to 5 print i, ",", i*i next i end
n	New – clear VM memory and code	
b	Bye: PICO – reboot VM in disk mode, Windows - exist	
l	l - Load program from EEPROM (auto.bas)	
s	s - Save program to EEPROM (auto.bas)	
ee	ee - EEPROM erase – now command disabled	
ed	ed - EEPROM dump – show EEPROM content	
is	I2C scan – show I2C devices on both I2C buses	
t0|t1|t2	**Program Flow Tracing**: t0 – OFF; t1 - Step Mode; t2 – Cont Mode	T1|T2 - enable tracing mode
@N	**Pico Editor:** @N - delete N-th line	@3 – removes 3rd line of code
@N <code>	**Pico Editor:** @N <code> - insert <code> before N-th line	@4 CLS – inserts 'CLS' before line 4

The BASIC language

Command	**Description/Comments**	**Example**
SM <entity> enable|disable	System Mode Configuration. Entity: ESC (default=enabled) - ESC key check (disable to boost performance) OLED (default=enabled) (NOTE: OLED auto-detection is supported now)	SM ESC disable SM OLED 1
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"

CONSTANTS

Command	**Description/Comments**	**Example**
ENABLE (1), DISABLE (0),	Generic constants	sm esc disable
HIGH (1), LOW (0)	Generic constants	dwrite 12,low
INPUT, OUTPUT, PULLUP, PULLDOWN, ADC, PWM, TSENSOR	GPIO constants usefull for hw GPIO modes	pmode 25,output dwrite 25,low

Suffixless varname and array syntax

-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(AND,OR,NOT)
NOTE: '<>' is equivalent to '!=', '=' is equivalent to '=='

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

BREAK	FOR and WHILE loops supported	while 1>0
		k=inkey()
		if(k!=0) then print k endif
		if(k==113) then break endif
		endwhile

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: 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 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 ‘,’ ‘;’ to skip NEW LINE	PRINT "6/3=", 6/3 (with NEW LINE) 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$(sexpr, expr)	Left part of the string	k$=LEFT$("abc", 2) + "123" i=12
RIGHT$(sexpr, expr)	Right part of the string	
MID$(sexpr,expr,expr)	Middle of the string	i$=MID$(STR$(i),2,3) PRINT i$
HEX$(expr)	Hex$(expr to hex string)	PRINT HEX$(NOT(0x0F))
STR$(expr)	Str$(expr to string)	
CHR$(expr)	Chr$(expr%256 to ascii e.g. 65 to ‘A’)	a=65 d$=chr$(a)
LEN(sexpr)	LEN(string length)	PRINT LEN("1234")->4
VAL(sexpr)	Val(string to value)	PRINT VAL("-1234")+1->-1233
ASC(sexpr)	ASC(ascii code of the 1st char of the string)	PRINT ASC(“AB”)->65
SIN(expr)	Sine	PRINT "SIN:",SIN(3.14/6)
COS(expr)	Cosine	PRINT "COS:",COS(3.14/6)
SQR(expr)	Square root	PRINT "SQRT:", SQR(5)
EXP(expr)	Expotential	PRINT "EXP:", EXP(1)
LOG(expr)	Logarithm	PRINT "LOG:", LOG(2.71)
SGN(expr)	Sign	PRINT "SGN:", SGN(-5)
ABS(expr)	Absolute	PRINT "ABS:", ABS(-5)
RND(max)	Hw-based rnd generator + von Neuman whitenizer	PRINT "RND: ", RND(1000)
GETTICK()	Tick number	a=gettick()
PAUSE msec	Delay (blocking) in msec	PAUSE 2*500
INKEY()	Pressed key, OR 0; non-blocking (no-wating)	
INT(expr)	QBASIC like	a=INT(1.1) b=INT(-1.1) PRINT a, ", ", b (1,-2)
FIX(expr)		c=FIX(1.9) d=FIX(-1.9) PRINT c, ", ", d (1,-1)
AND(expr,expr)		PRINT AND(0x3,0xF)
OR(expr,expr)		PRINT OR(0x3,0xF)
NOT(expr)		PRINT HEX$(NOT(0x0F))

PICO HARDWARE SUPPORT

Command	Description/Comments	Example
POKE addr, value	Memory write; hex supported	REM SYSTICK (ST) STCSR=0xe000e010 STRVR=0xe000e014 STCVR=0xe000e018 poke STCSR,0 poke STRVR,0x1e847 poke STCSR,5 for k=1 to 50 print and(peek(STCVR), 0x00FFFFFF) pause 1000 next k
PEEK(addr)	Memory read; hex supported	
PMODE pin, mode	m:0-IN,1-OUT,2-PULLUP,3-PULLDOWN, 10-ADC, 15-PWM, 20-TSENSOR	NOTE: As of 1.0b39 you can use HW CONSTANTS pmode 100, tsensor temp= aread(100)

AREAD(pin)	Read analog pin; pins=26-29 – analog; pin=100 – temperature virtual pin	pmode 26, adc voltage=aread(26) pmode 100,tsensor temp= aread(100)
AWRITE pin, cycles	PWM duty=cycles/65535 cycle: 0-65535)	pmode 22, pwm awrite 22, 16000
DREAD(pin)	Read digital pin	y=15 pmode y, input pmode y, pullup for k=1 to 2 step 0 pause 50 print dread(y) next k
DWRITE pin, value	Write digital pin	pmode 25,output dwrite 25,high pause 3000 dwrite 25,low

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

Command	**Description/Comments**	**Example**
SM OLED 1	Enable OLED support	NOTE: As of 1.0b31 OLED auto-detection is supported
LPLOT X, Y	Draw point at X, Y	for x=0 to 127 lplot x,fix(15+15*sin(6.28*x/128)) next x lref
LDRAW X0, Y0, X1, Y1	Draw line from X0, Y0 to X1, Y1	ldraw 10, 10, 20,20 lref
LCIRCLE x, y, r	Draw circle at x, y, r	lcircle 15, 15, 10
LPRINT expr, sexpr [AT x,y]	Print expr, sexpr separated by ‘,’ [AT x, y] (default 0,0)	lprint “2+2=”, 2+2 AT 10,10 lref
LCLS	Clear Screen (actually the buffer)	lcls lref
LREF	Refresh LCD (copy mem to LCD)	lref

I2C/UART/SPI SUPPORT ***(experimental)***

- the API is based on the PICO SDK API; all xread/xwrite commands are blocking; non-blocking approach theoretically possible by checking if the fifo is empty using xreadable/xwriteable functions

- limited comBuf buffer size to 256

- framework: xinit, xwrite, xread, xdeinit (where: x=i for i2c, u for uart, s for spi)

Command	**Description/Comments**	**Example**
IINIT ins, pin, pin[,baud] UINIT ins, pin, pin[,baud[,data,stop,parity]] SINIT ins, pin, pin[,baud[,format]]	initialize hw ins: i2c0, i2c1, uart0, uart1, spi0, spi1 defaults: i2c(400k), uart(115.2k,8,N,1), spi(10M)	REM UART loop-test l=8 integer bi(l), bo(l) for k=0 to l-1 bi(k)=k next k uinit uart0, 0, 1, 9600 uwrite uart0, bi, l pause 100 uread uart0, bo, l udeinit uart0 end
IREAD ins, ad, arr, len, nstop UREAD ins, arr, len SREAD ins, arr, len IWRITE ins, ad, arr, len, nstop UWRITE ins, arr, len SWRITE ins, arr, len	read / write operations ad: i2c device address arr: array name w/o brackets len: number of bytes nstop: 1-no Stop issued, 0-Stop issued	
IDEINIT ins; UDEINIT ins; SDEINIT ins	de-initialize hw	
IREADABLE(ins); IWRITABLE(ins) UREADABLE(ins); UWRITABLE(ins) SREADABLE(ins); SWRITABLE(ins)	for non-blocking write / write returns: 0,1;	