

Battery-powered, Bluetooth low energy PDP-11/40



Motivation

Well, this is an easy one: I'm a Bluetooth geek, and I'm also old enough to have spent many hours working on DEC PDP-11's in college. And because I wanted to do it.

Putting a Bluetooth interface on a serial port isn't exactly difficult, but in order to make the system compatible with iOS (and without Apple MFi), the interface needs to be Bluetooth low energy (BLE). BLE works on all computing platforms today....

This paper is not exactly a tutorial, but anyone with reasonable motivation and skill should be able to put the pieces together and get a working system. I'm not intending to provide any kind of support; use the websites provided for the components and you should be fine.

The app

I haven't investigated apps for Android. I'm sure there are android folks out there that will follow up with their favorites.

Probably the most difficult task was finding a capable BLE Terminal Emulator for iOS. There are only a couple that will work, and of those only one that works well enough with full-page style eliminated most, and even so they aren't real VT-100 emulation. I thought about trying to working with one of the VT-100 SWIFT packages on github, but didn't have the skill level required to do it in a reasonable amount of time.

Of the few apps available in the App Store, "**BLE Serial Pro**" is the one that came the closest to what I wanted, and has the ability to interface with multiple BLE Serial Services (there is no standard BLE Serial Service). After testing it and working with its author (Ed Nieuwenhuys) to address a bug with several iOS platforms, I'm pretty happy for puttering around. Maybe

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someone out there will address this with a real VT-100 app; let me know and I'll be happy to test it!

Wait, what? A PDP-11?

Well, it is an emulation. My favorite system to date is Sytse van Slooten's CYC-1000 based PDP-11 FPGA gate-based recreation, but I've been looking for a suitable platform for the battery-powered BLE version. In 2022 Ian Schofield ported and updated Dave Cheney's emulator to the Pi Pico (RP2040).

The Thing Plus RP2040 platform was exactly what I was looking for:

- Battery power capable with built-in charger
- Low power (roughly 75-80 mA at 3.3V)
- TTL/CMOS level serial inputs/outputs

As of this writing, I'm using Ian's March 2023 pre-compiled .uf2 for the Thing Plus board.

BLE Modules

Yes, there are a lot of them out there. I was looking for a turn-key module with a reasonable serial emulation built in, capable of running 9600 baud without handshaking. The Adafruit Bluefruit LE UART Friend fit the bill, is inexpensive and widely available. Also low power. Feel free to use another, but note that mileage will vary widely on serial emulation and some just plain won't work for this application.

The combination of the Thing Plus RP2040 and the Bluefruit module consumes about 85mA, so the 2000mAh battery shown will run for about 24+ hours on a full charge. Mileage will vary...

Parts list

- Adafruit Bluefruit LE UART Friend: <https://www.adafruit.com/product/2479>
 - Make sure to update it with the current (8.1 as of this writing) firmware; I used the Bluefruit app to do the firmware update.
- Sparkfun Thing Plus -RP2040: <https://www.sparkfun.com/products/17745>
- LiPo battery. Adafruit has several in different sizes/capacities. Note that some of these have different wiring for power/ground. Double check to make sure what you have is compatible with the Thing Plus board. You've been warned!
- Reasonable size SD card (I used 8GB)
- Hookup wire

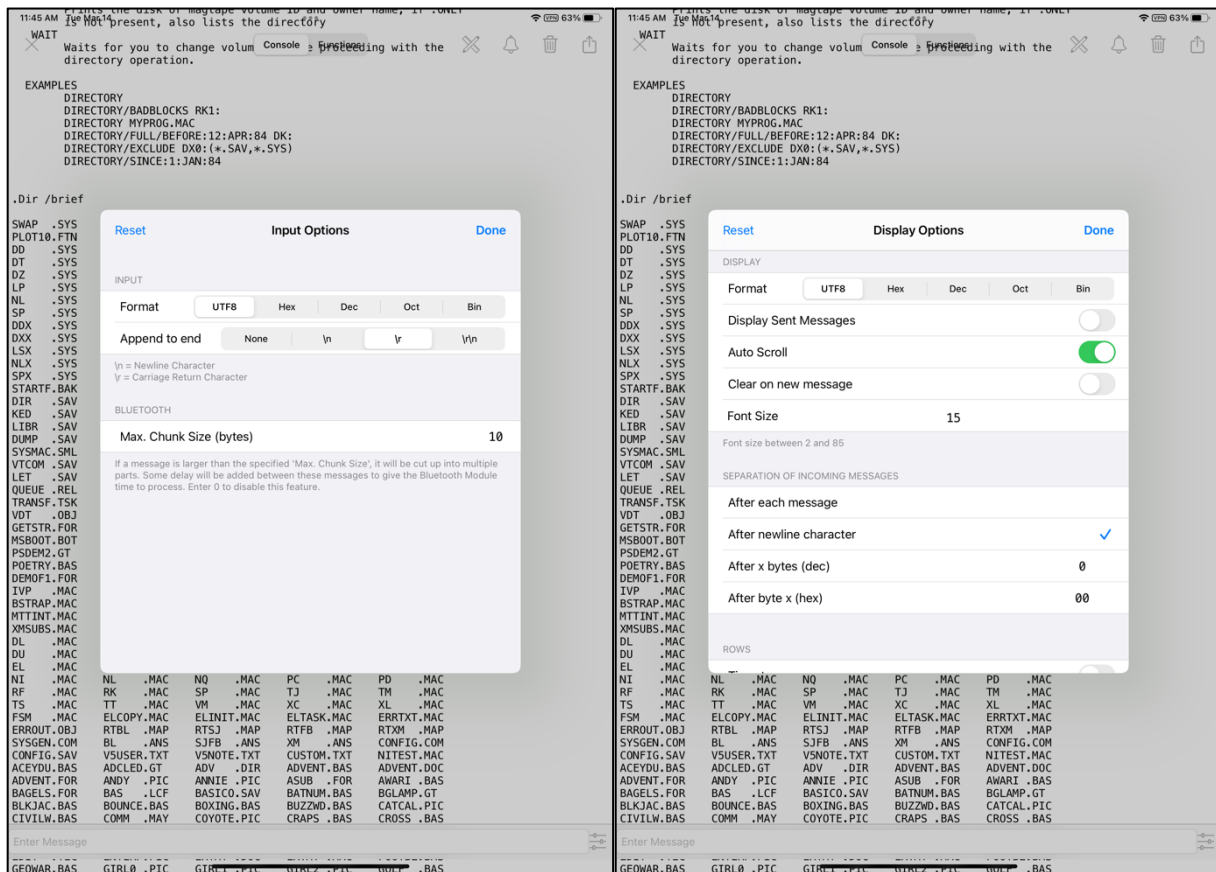
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Wiring

Signal	LE UART	ThingPlus
3.3V	Vin	3.3V
GND	GND	GND
TX	Tx	GPIO1 – Rx
RX	Rx	GPIO0 – Tx
CTS	CTS	GND
** Optional 2 nd serial port **		
TX2	Tx	GPIO21 – Rx2
RX2	Rx	GPIO20 – Tx2

BLE Serial Pro App Configuration

See screenshots below. See Ed's web page for any additional info.

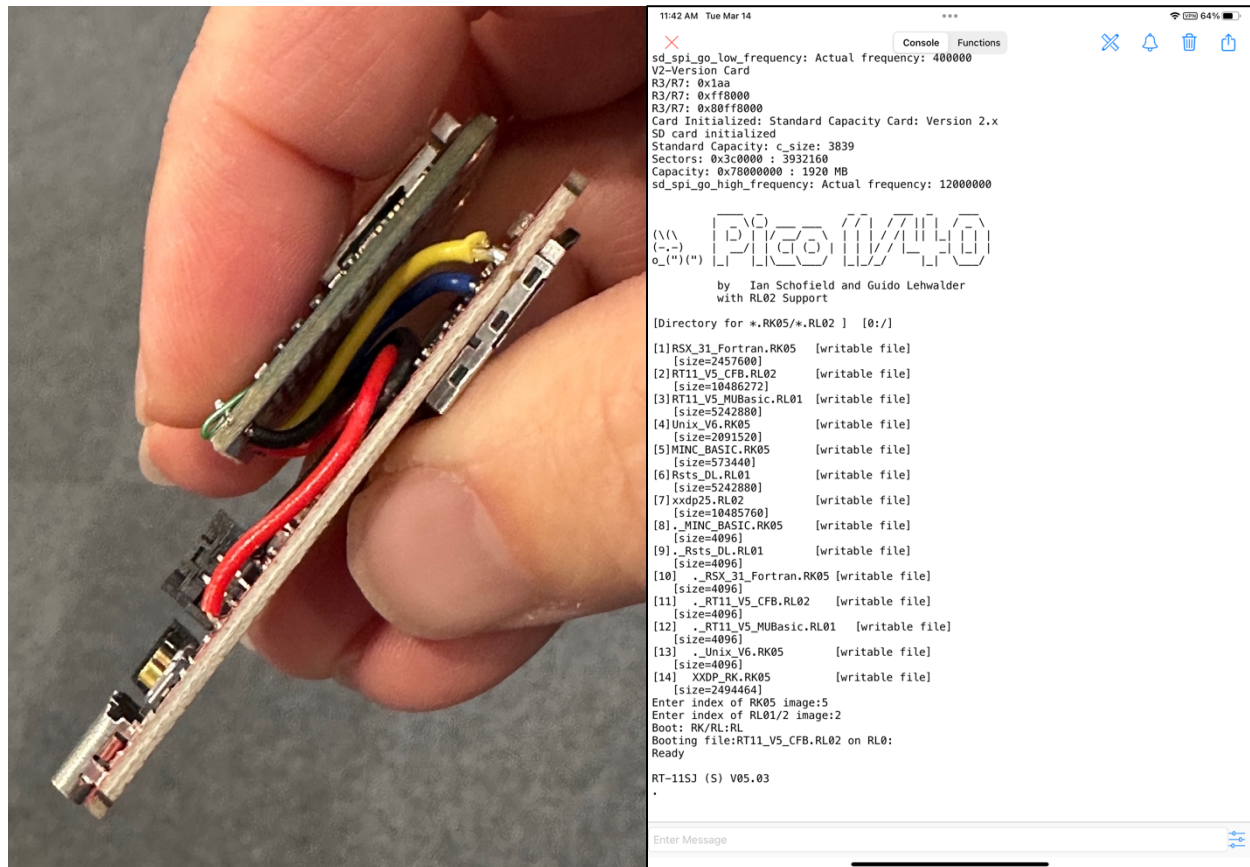
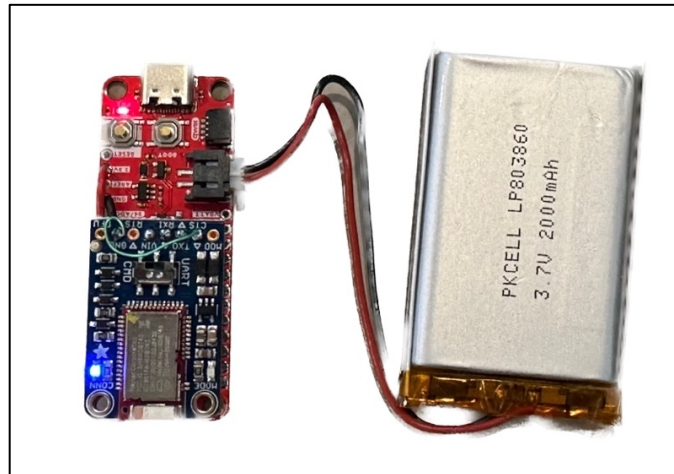


Additional Links:

- Sytse's website: <https://pdp2011.sytse.net/wordpress/>
- Ian's github: https://github.com/lsysxp/Pico_1140
- Ed's BLE Serial Pro: <https://ednieuw.home.xs4all.nl/BLESerial/BLESerialPRO.html>

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Some Photos



Battery-powered, Bluetooth low energy PDP-11/40

RT-115J (S) V05.03
RT-115J (S) V05.03
Booted from DL0:RT115J

Console Functions

USR is set SWAP
EXIT is set SWAP
KMON is set NOIND
TT is set NOQUIET
ERROR is set ERROR
SL is set OFF
EDIT is set KED
KMON nesting depth is 3

PDP 11/45,50,55 Processor
192KB of memory
Extended Instruction Set (EIS)
Floating Instruction Set (FIS)
Memory Management Unit
50 Cycle System Clock
No SYSGEN options enabled

Device	Status	CSR	Vector(s)
CR	Not installed	177160	230
CT	Installed	000000	260
DD	Installed	176500	300 304
DL	Resident	174400	160
DM	Not installed	177440	210
DP	Not installed	176710	254
DS	Not installed	172040	204
DT	Not installed	177340	214
DU	Not installed	172150	154
DW	Not installed	000000	
DX	Not installed	177170	264
DY	Not installed	177170	264
DZ	Not installed	000000	
PD	Not installed	000000	
RF	Not installed	177460	204
RK	Installed	177400	220
LD	Not installed	000000	000
LP	Not installed	177514	200
LS	Not installed	176500	470 474 300 304
MM	Not installed	172440	224
MS	Not installed	172522	224 300
MT	Not installed	172520	224
NL	Not installed	000000	000
PC	Not installed	177550	070 074
PI	Not installed	000000	000
SL	Not installed	000000	000
SP	Not installed	000000	110
TT	Installed	000000	000
VM	Not installed	177572	250
XC	Not installed	173300	210 214
XL	Not installed	176500	300 304
BA	Not installed	000000	000

TT
DL (Resident)
DL0 = DK, SY

CT
DD
RK

Job	Name	Console	Level	State	Low	High	Impure
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Enter Message

No multi-terminal support

Address Module Mode

11:44 AM 64%
11:44 AM 63%

Wait
Waits for you to change volume before proceeding with the directory operation.

EXAMPLES
DIRECTORY
DIRECTORY/BADBLOCKS RK1:
DIRECTORY/MYPROG.MAC
DIRECTORY/FULL/BEFORE:12:APR:84 DK:
DIRECTORY/EXCLUDE DX0:(*.SAV,*.SYS)
DIRECTORY/SINCE:1:JAN:84

.Dir /brief

SWAP .SYS	RT11AI.SYS	RT11PI.SYS	RT11BL.SYS	XX1 .DSP
PLOT10.FTN	RT11FB.SYS	RT11XM.SYS	CR .SYS	CT .SYS
DD .SYS	DL .SYS	DM .SYS	DP .SYS	DS .SYS
DT .SYS	DU .SYS	DW .SYS	DX .SYS	DY .SYS
DZ .SYS	PD .SYS	RF .SYS	RK .SYS	LD .SYS
LP .SYS	LS .SYS	MM .SYS	MS .SYS	MT .SYS
NL .SYS	PC .SYS	PI .SYS	SL .SYS	SLMN .SYS
SP .SYS	TT .SYS	VM .SYS	XC .SYS	XL .SYS
DDX .SYS	DLX .SYS	DMX .SYS	DDX .SYS	DMX .SYS
DDX .SYS	DYX .SYS	DZX .SYS	LDX .SYS	LTX .SYS
LSX .SYS	MMX .SYS	MSX .SYS	MTX .SYS	NCX .SYS
NLX .SYS	NOX .SYS	PIX .SYS	RKX .SYS	SLX .SYS
SPX .SYS	VMX .SYS	XCX .SYS	XLX .SYS	STARTA.COM
STARTF.BAK	STARTS.COM	STARTX.COM	PTP .SAV	DUP .SAV
DIR .SAV	IND .SAV	RESORC.SAV	QEDIT .SAV	KS2 .SAV
KED .SAV	KEX .SAV	MACRO .SAV	CREP .SAV	LNK .SAV
LIBR .SAV	FILEX .SAV	SRCOM.SAV	BINCOM.SAV	SLP .SAV
DUMP .SAV	SIPP .SAV	BUP .SAV	PAT .SAV	HELP .SAV
SYSMAC.SML	BATCH .SAV	ERROUT.SAV	QUEMAM.SAV	SETUP .SAV
VTCOM .SAV	SPEED .SAV	DECAY .GT	DRAW .GT	DATIME.COM
LET .SAV	SPLIT .SAV	UCL .SAV	VBGEKE.SAV	TERID.SAV
QUEUE .REL	RTMON .REL	SPOOL .REL	VTCOM .REL	TRANSF.SAV
TRANSF.TSK	TRANSF.EXE	GIDIS .SAV	ALPH00.FNT	ODT .OBJ
VOT .OBJ	VTMAC .MAC	VTDLR.OBJ	SYSLIB.OBJ	PUTSTR.FOR
GETSTR.FOR	MODUL2.MAY	NICOMA.BAS	MBOT .BOT	MBOT16.BOT
MSBOOT.BOT	MDUP .MT	POD .COM	POD .PIN	PSDEM1.GT
PSDEM2.GT	MDUP .MS	MDUP .SAV	MEMADJ.MAY	PLANE .PIC
POETRY.BAS	SAIL .GT	DEMOBG.MAC	DEMOFG.MAC	DEMOX1.MAC
DEMOF1.FOR	DEMOED.TXT	SAMPLE.KED	VERIFY.COM	IYP .COM
IYP .MAC	MTB .COM	FB .MAC	SJ .MAC	XI .MAC
BSTRAP.MAC	EDTGBL.MAC	KMON .MAC	KMOVLY.MAC	MTTENT.MAC
MTTINT.MAC	RMONFB.MAC	RMONSJ.MAC	TRMTBL.MAC	USR .MAC
XMSUBS.MAC	BA .MAC	CR .MAC	CT .MAC	DD .MAC
DL .MAC	DM .MAC	DP .MAC	DS .MAC	DT .MAC
DU .MAC	DW .MAC	DX .MAC	DY .MAC	DZ .MAC
EL .MAC	LD .MAC	LP .MAC	LS .MAC	NC .MAC
NI .MAC	NL .MAC	NQ .MAC	PC .MAC	PD .MAC
RF .MAC	RK .MAC	SP .MAC	TJ .MAC	TM .MAC
TS .MAC	TT .MAC	VM .MAC	XC .MAC	XL .MAC
FSM .MAC	ELCOPY.MAC	ELINIT.MAC	ELTASK.MAC	ERRXT.MAC
ERROUT.OBJ	RTBL .MAP	RTSJ .MAP	RTFB .MAP	RTXM .MAP
SYSGEN.COM	BL .ANS	SJFB .ANS	XI .ANS	CONFIG.COM
CONFIG.SAV	VUSER.TXT	VNOTE.TXT	CUSTOM.TXT	NITEST.MAC
ACEYD.BAS	ADCLD.GT	ADV .DIR	ADVENT.BAS	ADVENT.DOC
ADVENT.FOR	ANDY .PIC	ANNIE .PIC	ASUB .FOR	AWARI .BAS
BAGELS.FOR	BAS .LCF	BASICO.SAV	BATNUM.BAS	BGLAMP.GT
BLKJAC.BAS	BOUNCE.BAS	BOXING.BAS	BUZZWD.BAS	CATCAL.PIC
CTVILW.BAS	COMM .MAY	COYOTE.PIC	CRAPS .BAS	CROSS .BAS

Enter Message

GEOWAR.BAS GIRL0 .PIC GIRL1 .PIC GIRL2 .PIC GULP .BAS