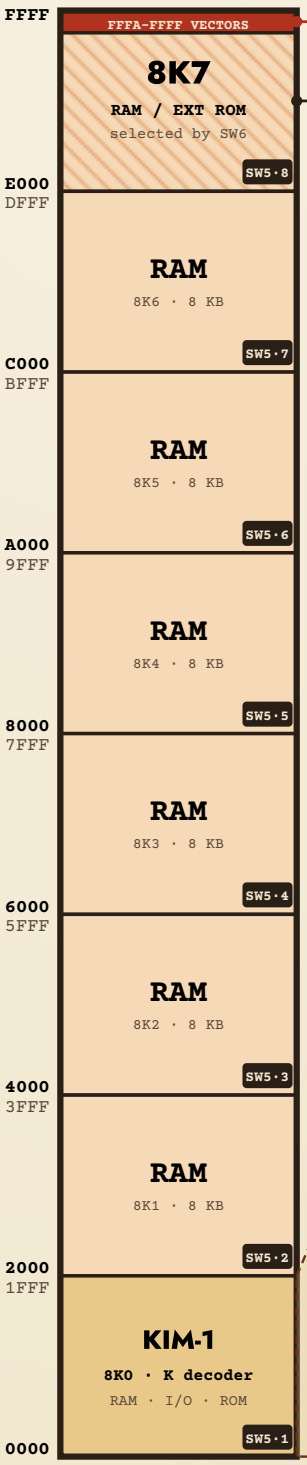
PAL-II MEMORY MAP

64 KB · 8 × 8K

SW5 (8K_EN) · U8 74LS145



BLOCK 8K7 · $E000–$FFFF · SW5·8 + SW6 (RAM/ROM)

SW5·8 OFF → block disabled, free for expansion.

SW5·8 ON + SW6 **RAM** (→, pos. 1) → 8 KB RAM from U7.

SW5·8 ON + SW6 **ROM** (←, pos. 3) → signal **8K7_SELECT** drives /CE of an external 28C64 EEPROM (8 KB) via APP pin **L**. Pull-up R39 1k: without SW5·8, 8K7_SELECT stays inactive (H).

Note: SW6 has only 2 positions — RAM and 8K7_SELECT are exclusive.

VECTORS · $FFFA–$FFFF · SW7 (VECTOR)

SW7 KIM (↓, closed): U22 74LS133 detects $FFF8-$FFFF and forces K7 → read from PAL-II ROM at $1FF8-$1FFF; 8K7_ROM (APP **M**) = H, so /OE of the external 28C64 is disabled.

SW7 ROM (open): 8K7_ROM = L, CPU fetches vectors from block 8K7 (external ROM or RAM — RAM at power-up = random RESET!).

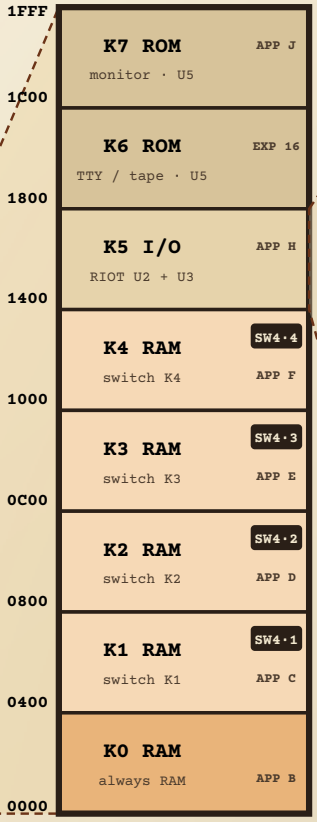
NMI $FFFA→$1C1C JMP ($17FA) values apply to SW7 = KIM

RST $FFFC→$1C22

IRQ $FFFE→$1C1F JMP ($17FE)

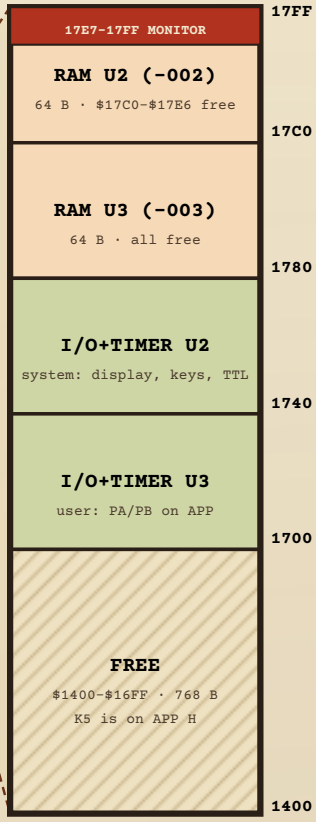
BLOCK 0 · 8 × 1K

K0–K7 · U6 74LS145 · SW4



K5 · $1400–$17FF

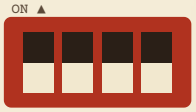
U4 74LS138 (A6-A9)



1 = ON = closed
ON → RAM · OFF → free

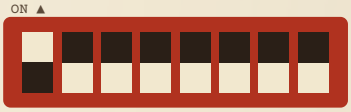
K0: $0000-$00FF zero page ($EF-$FF monitor) · $0100-$01FF stack · $0200- program
Keep SW5·1 OFF (K decoder handles block 0); ON = RAM over all of block 0 incl. ROM/RIOT.

SW4 K1–K4 RAM



default **1111** · $0400-$13FF RAM

SW5 8K_EN



default **01111111** · $2000-$FFFF RAM

SW6 8K7



default **RAM** (pos. 1)

SW7 VECTOR



default **KIM** (closed)

2 × 22 PIN · 2.54 MM · KIM-1 COMPATIBLE

PAL-II CONNECTORS

J2 APPLICATION (A)

lower left · U3 6532-003 ports · keypad · TTL

LOWER ROW			UPPER ROW ^
+5 V (VCC)	A	1	GND (VSS)
K0 ($0000)	B	2	PA3 (U3)
K1 ($0400)	C	3	PA2 (U3)
K2 ($0800)	D	4	PA1 (U3)
K3 ($0C00)	E	5	PA4 (U3)
K4 ($1000)	F	6	PA5 (U3)
K5 ($1400)	H	7	PA6 (U3)
K7 ($1C00)	J	8	PA7 (U3)
DECODE EN (DEC_EN)	K	9	PB0 (U3)
8K7_SELECT → /CE 28C64	L	10	PB1 (U3)
8K7_ROM → /OE 28C64	M	11	PB2 (U3)
—	N	12	PB3 (U3)
—	P	13	PB4 (U3)
—	R	14	PA0 (U3)
—	S	15	PB7 (U3)
TTL IN KYBD ← TX USB-TTL	T	16	PB5 (U3)
TTL OUT PTR → RX USB-TTL	U	17	KB ROW 0
KB ROW 3 (TTY: ↔ 21)	V	18	KB COL F
KB COL G	W	19	KB COL B
KB ROW 2	X	20	KB COL E
KB COL C	Y	21	KB COL A (TTY: ↔ V)
KB ROW 1	Z	22	KB COL D

J1 EXPANSION (E)

upper left · 6502 bus

LOWER ROW			UPPER ROW ^
AB0	A	1	SYNC
AB1	B	2	RDY
AB2	C	3	Ø1
AB3	D	4	/IRQ
AB4	E	5	SO (set overflow)
AB5	F	6	/NMI
AB6	H	7	/RST
AB7	J	8	DB7
AB8	K	9	DB6
AB9	L	10	DB5
AB10	M	11	DB4
AB11	N	12	DB3
AB12	P	13	DB2
AB13	R	14	DB1
AB14	S	15	DB0
AB15	T	16	/K6 ($1800-$1BFF)
Ø2	U	17	SST OUT
R/W	V	18	—
/R/W (inverted)	W	19	—
PLL TEST	X	20	—
/Ø2 (inverted)	Y	21	+5 V (VCC)
RAM R/W	Z	22	GND (VSS)

power · port A / data · port B · keypad / address · memory decoder · TTL / CPU control · not connected

APPLICATION · TIPS

- **+5 V on A, GND on 1** (or Expansion 21/22).
- USB-TTL: TX → **T** (TTL IN KYBD), RX ← **U** (TTL OUT PTR).
- TTY mode: jumper **V ↔ 21** (KB Row 3 - KB Col A), then RS and Enter (auto-baud).
- PA0-PA7 / PB0-PB7 = U3 at $1700-$1703. **PB6 is not brought out.**
- K0-K7 active low (74LS145, OC) for expansion in block 0.

EXPANSION · TIPS

- **K6** (pin 16) = $1800-$1BFF, i.e. the U5 ROM area.
- **RAM R/W** (Z) = R/W gated with Ø2 for RAM writes.
- **SST OUT** (17) = single-step output (SST switch).
- Pins 18-20 not connected; PAL-II has no audio (PLL TEST only brought out).
- **8K7_SELECT** and **8K7_ROM** for an external 28C64 are on APP **L** and **M**.

Source: PAL-II User Manual V1.0, fig. 3 and 4 · PAL-2 schematic rev 3

Pin 1 / A is at the top, next to the "A|1^" mark

RESERVED LOCATIONS

addresses in hex · KIM-1 monitor
6530-002 / -003 image in U5

ADDRESS	SYMBOL	MEANING
ZERO PAGE & STACK		
0000-00EE	—	free for user
00EF	PCL	saved PC (low)
00F0	PCH	saved PC (high)
00F1	PREG	saved status register P
00F2	SPUSER	saved stack pointer
00F3	ACC	saved accumulator
00F4	YREG	saved Y
00F5	XREG	saved X
00F6-F7	CHKHI/SUM	checksum (tape / paper tape)
00F8	INL	input buffer low · data on display
00F9	INH	input buffer high
00FA	POINTL	address on display (low)
00FB	POINTH	address on display (high)
00FC	TEMP	scratch
00FD	TMPX	scratch X
00FE	CHAR	TTY character
00FF	MODE	monitor mode (AD/DA)
0100-01FF	STACK	6502 stack (RST sets SP=$FF)
0200-03FF	—	usual program start (**0200 G**)
RIOT U3 6532-003 · USER (APP CONNECTOR)		
1700	PAD	port A data · PA0–PA7
1701	PADD	port A direction (1 = output)
1702	PBD	port B data · PB0–PB5, PB7
1703	PBDD	port B direction (1 = output)
1704-1707	TIMER	write: ÷1 · ÷8 · ÷64 · ÷1024, no IRQ
170C-170F	TIMER	write: same, with IRQ
1706 / 1707	RD	read: counter / underflow flag (bit 7)

MONITOR · COMMANDS	
KEYPAD	**TTY (UPPERCASE ONLY)**
AD address · **DA** data	**xxxx␣** open address
+ next address	**yy.** store byte, step on
GO run from address	**CR** next · **LF** previous
PC recall saved PC	**G** run from open address
ST stop (NMI)	**Q** dump to paper tape (SAL-EAL)
RS reset · **SST** single step	**L** load paper tape (.pap)

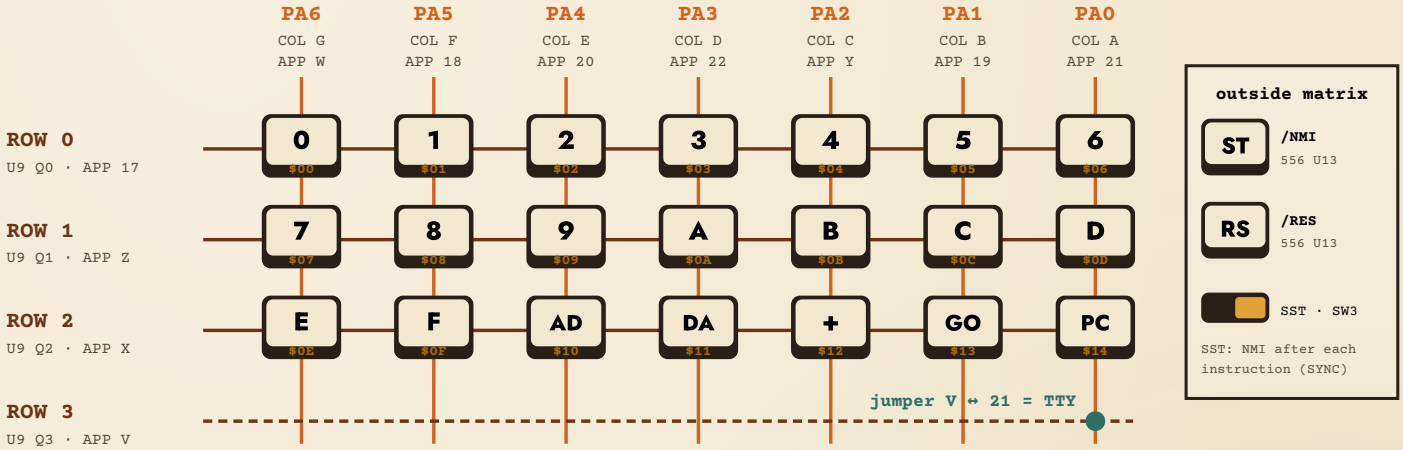
ST and SST only work when NMIV ($17FA) = $1C00. BRK into monitor: IRQV ($17FE) = $1C00. TTY: 8N1, auto-baud after RS + Enter.

ADDRESS	SYMBOL	MEANING
RIOT U2 6532-002 · SYSTEM (DO NOT USE)		
1740	SAD	display segments / keypad columns · PA7 = TTL IN
1741	PADD	port A direction
1742	SBD	digit / row select · PB0 = TTL OUT
1743	PBDD	port B direction
1744-1747	CLK1T…KT	timer ÷1 · ÷8 · ÷64 · ÷1024 (used by monitor)
RIOT RAM		
1780-17BF	—	RAM U3 · 64 B free
17C0-17E6	—	RAM U2 · 39 B free
17E7-17E8	CHKL/H	checksum
17E9-17EB	SAVX	scratch (3 B)
17EC-17F1	VEB	“volatile execution block” (6 B)
17F2-17F3	CNTL/H30	TTY speed constant (auto-baud)
17F4	TIMH	scratch (TTY timing)
17F5-17F6	SAL/SAH	start address (tape)
17F7-17F8	EAL/EAH	end address (tape)
17F9	ID	tape record ID
17FA-17FB	NMIV	NMI vector → set to **$1C00** for ST / SST
17FC-17FD	RSTV	RST vector (user)
17FE-17FF	IRQV	IRQ/BRK vector → **$1C00** = BRK into monitor
MONITOR ROM U5 · USEFUL ROUTINES		
1800	DUMPT	save to cassette*
1873	LOADT	load from cassette*
1C00	SAVE	monitor entry (NMI/BRK), saves registers
1C22	RST	monitor reset
1C4F	START	return to monitor (JMP)
1E1E	PRTPNT	print POINTH/L to TTY
1E2F	CRLF	print CR LF
1E3B	PRTBYT	print A as 2 hex digits
1E5A	GETCH	TTY character → A (alters X, Y)
1E9E	OUTSP	print space
1EA0	OUTCH	print character in A to TTY
1F1F	SCANDS	show POINTH POINTL INH on display
1F40	KEYIN	key pressed? (A ≠ 0)
1F6A	GETKEY	key code → A ($15 = none)
1F9D	GETBYT	2 hex chars from TTY → A

* PAL-II has no cassette audio circuits; the routines remain in ROM.

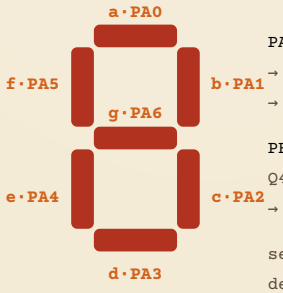
KEYPAD · DISPLAY · TTY

A KEYPAD · 3 × 7 MATRIX



Read: PADD=$00, select row in SBD; key down → column bit in SAD = 0. GETKEY ($1F6A) returns the code (yellow), $15 = none.

B DISPLAY · 6 × 7 SEGMENTS



PA0–PA6 (U2, SAD)
→ 74LS06 U21 (d: U12A)
→ 680 Ω → cathodes a–g

PB1–PB4 → 74LS145 U9
Q4–Q9 → PNP 2N4403
→ digit common anode

segment lit when bit = 1
decimal point not used



POINTH POINTL INH — SCANDS ($1F1F)

PB4–1	SBD *	U9	SELECTS	APP
0	$01	Q0	ROW 0 · keys 0–6	17
1	$03	Q1	ROW 1 · keys 7–D	Z
2	$05	Q2	ROW 2 · E F AD DA + GO PC	X
3	$07	Q3	ROW 3 · TTY jumper test	V
4–9	$09–$13	Q4–Q9	digits 1–6 (from left) · PNP Q1–Q6	—

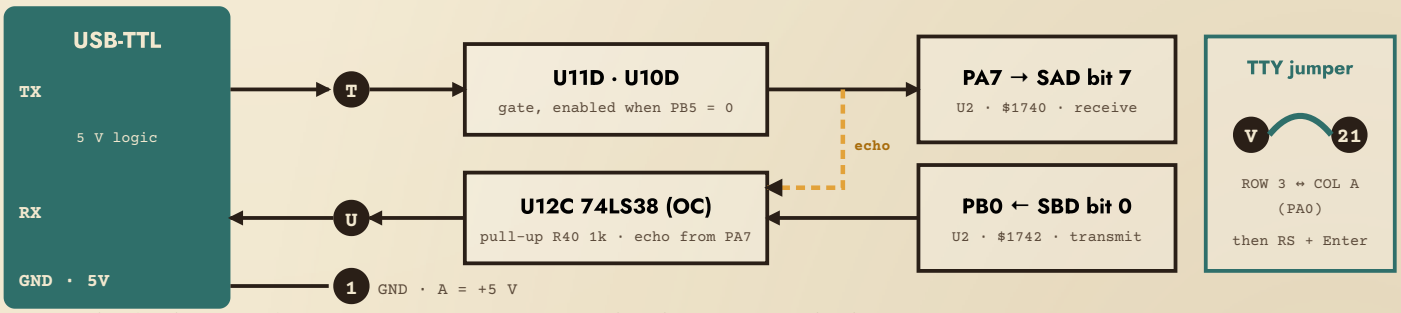
* SBD ($1742) = (number << 1) | 1 — PB0 keeps TTL OUT idle, PB5 = 0 enables TTL IN.

HEX → SEGMENTS (PA6…PA0) · ROM TABLE AT $1FE7

0	3F	4	66	8	7F	C	39
1	06	5	6D	9	6F	D	5E
2	5B	6	7D	A	77	E	79
3	4F	7	07	B	7C	F	71

Multiplex: PADD=$7F, write segments to SAD, select digit in SBD, ~500 cycles, next. For keypad reads PADD=$00.

C TTY · TTL SERIAL LINE



Idle = H (logic 1). Start bit = L. APP connector: T = TTL IN (KYBD), U = TTL OUT (PTR).

MODE SELECT

- START reads ROW 3 / PA0 (COL A).
- Jumper **V ↔ 21** pulls PA0 low → **TTY**.
- No jumper → keypad + display.

SPEED

- 8N1, no flow control. Manual: 1200 Bd, 9600 usually works.
- RS, then **Enter**: monitor times the start bit → $17F2/F3.

SOFTWARE

- INIT1: PADD=$00, PBDD=$3F, SBD=$07.
- Output PB0, start bit = 0. Input PA7.
- Echo is done in hardware → turn off local echo in the terminal.