

# CPC Universal 512K Ram Expansion RC-2-Bulldog Release Notes

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## Summary

This is a universal 512K RAM expansion card for all Amstrad CPC models.

The board has an 'M4' connector so requires a suitable motherboard or adapter to mount on the CPC.

On the 6128 and later computers the board provides a full 512K RAM expansion following the DK'Tronics/Amstrad specification.

On 464 and 664 computers the board will provide either

- a full 512K RAM expansion with the same limitations on mode C3 which the DK'Tronics and other available '464 RAM cards have (e.g. X-MEM, Zaxon), or
- a slightly smaller 448K expansion with full CPC6128 compatibility in mode C3, where one 64K banks is given up and used to shadow internal RAM.

Current status is that the card is fully working for the 6128/Plus computers, but the 464/664 modes are still in development. Release notes follow with more detail.

## Release Notes

RC-2-Bulldog is the second release candidate for alpha testing.

The ability to run in overdrive mode without shadow memory is restored - this was disabled in the previous release candidate.

The code has been improved to be able to backdrive ADR15 in mode 3 if required before the first rising clock edge in a valid mreq cycle. Previously this was being driven based on the value of a FF clocked by that edge and there was a race between the CPLD version of the clock and CPC clock. This showed up as a voltage dependency in FutureOS which meant that the cursor was only visible when the supply was ramped up above 5V. This issue is resolved in the new code and Future OS works down to around 4.25V as all other tests attempted at that voltage.

CC will not be created. RD\_\* as an error code attempted at that stage.

At the other end of the valid MREQ cycle the RD\* overdriving, if required, has been extended to the next trailing clock edge after rising MREQ\* after seeing slightly different behaviour between the original prototype card (always reliable) and a second card just made up for mode testing (very occasional base RAM fails in the TEST.bin memory test). With this fix both cards now appear to behave identically and correctly.

The DIP Switches work as follows

DIP	Function
1	ON selects 464 mode which overdrives RD_B and ADR15 as required, OFF selects 6128/Plus mode
2	turns on shadow memory
3	selects partial shadow memory for mode3 only (OFF), or full shadow memory (ON) using SRAM instead of CPC base RAM for all addresses.
4	selects shadow memory bank as low bank 3 (OFF) or high bank 7 (ON).

When setting DIP4 be careful because the DK'Tronics Silicon Disk software does not do a good check of the memory available. SDISC will declare banks 4-7 available for the disk even if DIP4 is set ON which effectively means that bank7 is not available.

***NB - for DIP switches 3 and 4 to take effect you need to power cycle the CPC. These switches are read and latched only on startup.***

Recommended DIP settings in this release candidate are

Config.	DIP1	DIP2	DIP3	DIP4	Application	Comment
1	OFF	OFF	OFF	OFF	6128 or Plus computers	Disable overdrive and shadow memory and provide a full 512K expansion
2	ON	ON	OFF	OFF	464 or 664 computer using DK'Tronics silicon disk	Provides a 448KB extension which can be used as a 256K silicon disk + a 192K RAM expansion

					silicon disk	RAM expansion
3	ON	ON	OFF	ON	464 or 664 computer not using DK'T silicon disk	Provides a 448KB extension
4	ON	ON	ON	OFF	464 or 664 computer using DK'Tronics silicon disk	Provides a 448KB extension which can be used as a 256K silicon disk + a 192K RAM expansion using full shadow memory so that all memory reads always come from the SRAM
5	ON	ON	ON	ON	464 or 664 computer not using DK'T silicon disk	Provides a 448KB extension, using full shadow memory so that all memory reads always come from the SRAM
6	ON	OFF	OFF	OFF	464 or 664 computers	This is the true DK'Tronics mode which does not fully support mode C3 in the same way as on the 6128, but does provide a full 512K expansion and for most purposes is sufficient - see the results table below.

Other configurations are possible, but not currently tested or recommended.

Note when running a 464 in configurations 4 or 5 (full shadow memory) the base RAM of the CPC is only ever used for video data. Thus this card can potentially revive dead CPCs which have faulty base RAM with the only proviso that any faults in video RAM will result in visible pixel corruption on screen. Full shadow mode has been tested with Gerald's RamTest ROM - see below.

## Testing Results

Several cards have been tested now using 3 different CPCs: 1x CPC464 and 2xCPC6128s

Full tests have been run at 4.8V, but some additional tests have been run in the voltage range 4.25V through 5.5V.

Full Test results are visible on Google Sheets here

[https://docs.google.com/spreadsheets/d/11wxhIDWy2wNmKSXZwBqjqQjMN2nNZDtLEvy6\\_GrM8I/edit?usp=sharing](https://docs.google.com/spreadsheets/d/11wxhIDWy2wNmKSXZwBqjqQjMN2nNZDtLEvy6_GrM8I/edit?usp=sharing)

## Power Consumption

Supply Voltage	Current	Comment
4.25V	70mA	Technically below the minimum operating voltage of the CPLD, but all tests tried at this voltage (see table above) have passed
4.5V	85mA	
4.75V	95mA	Likely supply voltage if used on Mother X4 due to schottky diode drop
5.0V	105mA	Nominal 5V to match CPC
5.25V	120mA	
5.5V	145mA	