Engineering Support Application Note
Number: 297
Issue: 1.00

Hardware Modification and Testing Procedures to enhance StrongARM / PC Card compatibility

This Application Note details a number of hardware and software test procedures to troubleshoot some problems which have been observed when a StrongARM and a PC Card coexist in the same system. The modifications described herein should **NOT** be attempted by **ANYONE** who does not have access to specialised SMT tools or who has not been trained in surface-mount soldering and antistatic handling techniques, and in any case such modifications will void the hardware warranties.

Applicable Hardware :	Any machine equipped with a StrongARM and / or a PC Card	Related Application Notes:	None

Distribution: **CONFIDENTIAL**

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Introduction

A number of problems have recently been brought to our attention which involve StrongARM compatibility and stability of PC cards in a small number of Risc PCs. The aim of this document is to describe in detail the testing procedures needed to troubleshoot a machine exhibiting any of this range of problems, and isolate and correct their causes.

This document is not a Field Change Order, nor does Acorn have a policy to provide financial recompense for time and effort spent in applying the procedures described below.

Troubleshooting Procedure

In order to minimise the number of components which can contribute to the observed problems, any system should be stripped down to a minimal configuration before troubleshooting commences. Wherever possible any podules should be removed before starting, and the system should be configured only to access the hard discs containing the RISC OS boot hierarchy and any required DOS partitions. If any salient partitions exist on, eg SCSI drives requiring the presence of a drive interface card, only that card should be left in the machine.

The troubleshooting procedures below are intended to address the following symptoms:

Case 1: StrongARM does not work correctly under RISC OS. Often characterised by data aborts when booting, but can be more subtle (eg known compatible versions of apps crashing / machine locking up randomly when in use). Trying a different StrongARM card does not cure the problem.

Case 2: StrongARM and RISC OS are stable without PC Card fitted, PC card does not boot (ROM checksum failure etc) or is unstable. PC Card works as normal when StrongARM is removed and ARM610 / ARM710 is used instead. Trying a different PC Card and / or StrongARM card with the same modification level has no effect.

Case 3: StrongARM and RISC OS are stable, PC card is unstable / does not boot. Changing the ARM processor has no effect, and changing the PC Card does not endow stability either.

Case 1:

Ensure that the RISC OS 3.70 software ROM patches have been installed (look for a directory "ROMPatches" in !Boot.Choices.Boot.PreDesk). If the patches are not present, obtain them from ftp.acorn.co.uk (they may be found as /pub/riscos/patches/riscos370sa.arc), install them and soak test as per "Testing StrongARM Stability under RISC OS" below.

Strip the machine down, removing all podules (where feasible) and the PC Card.

Follow the procedure in "Testing StrongARM Stability under RISC OS" below.

If StrongARM does not prove stable, remove the VRAM (if fitted) and test again; if this does not work, replace the machine's exisitng DRAM with one SIMM of DRAM known to work with StrongARM and test again.

Replace DRAM or VRAM if testing above shows them to be contributing to the problem, and test again with the replacements.

If tests still do not pass and there is no other possible systematic problem (eg a dry joint on a SIMM socket connection) modify StrongARM as below and test again.

If this does not solve the problem, refer to "If All Else Fails..."

Case 2:
Ensure that a StrongARM-compatible version of !PCx86 or PC Pro is in use. !PCx86 version 1.93 (available for download from ftp.acorn .co.uk as /pub/riscos/releases/pccard/pcx86.arc) is generally suitable for text-based applications, although the ARMDRV.DRV graphics driver will produce some visual inconsistencies in graphic displays owing to the presence of self-modifying code. All versions of PC Pro >= 2.02 *should* work with StrongARM; verify the compatibility of the version in use with Aleph 1.

Strip the machine down, removing all podules (where feasible).

Examine the PC Card, as in "Examination and Modification of PC Cards" below.

Modify the PC card if necessary.

Insert the PC Card and soak test the StrongARM under RISC OS. If StrongARM does not prove stable, examine the StrongARM to see if it has been modified. If it has not, remove the VRAM (if fitted) and test again; if this does not work, replace the machine's exisiting DRAM with one SIMM of DRAM known to work with StrongARM and test again.

If this does not work, modify the StrongARM card and repeat the step above.

Soak test the PC Card under DOS. If the soak fails, remove the VRAM (if fitted) and test again; if this does not work, replace the machine's exisiting DRAM with one SIMM of DRAM known to work with StrongARM and test again.

If this does not solve the problem, refer to "If All Else Fails..."

Case 3:
Strip the machine down, removing all podules (where feasible).

Examine the PC Card, as in "Examination of PC Cards" below.

Modify the PC card if necessary.

Insert the PC Card and soak test under DOS. If the soak fails, remove the VRAM (if fitted) and test again; if this does not work, replace the machine's exisiting DRAM with one SIMM of DRAM known to work with StrongARM and test again.

If this does not solve the problem, refer to "If All Else Fails..."

Testing StrongARM Stability under RISC OS

In most cases, StrongARM instability will manifest itself at boot time, resulting in data aborts or other similar errors before the boot sequence has finished executing. If this does not occur but the machine appears to be subject to random crashes or other unusual behaviour when known and only known StrongARM-compatible versions of RISC OS applications are running (check http://www.art.acorn.co.uk/strongarm/sacompat.html for a list of compatible apps), then ensure that the RISC OS 3.70 software ROM patches have been installed (look for a "ROMPatches" directory in !Boot.Choices.Boot.PreDesk). If the patches are not present, obtain them from ftp.acorn.co.uk (they may be found as /pub/riscos/patches/riscos370sa.arc).

Check the positions of the switches in the block on the StrongARM card; they should all be down. You should also be sure to check the status of the solder links on the reverse of the card in the area of the switches; the middle two switches should be shorted out. If these links have been changed in any way, the card has been tampered with by the user and its warranty is void.

If the ROM patches have been installed and sporadic crashes are still observed, shut the system down and move the leftmost switch in the block on the StrongARM card up before testing again; if the system works in this configuration (even though it will be running more slowly than a "known good" StrongARM system) then the StrongARM is faulty.

Many RISC OS titles are suitable for use in StrongARM testing, however probably the best option is to run the continuous soak test available as part of the Risc PC Dealer Test suite (available from the Dealer WWW site). Soaking should be done for several hours, eg overnight.

Modification of StrongARM cards

If the system appears to be unstable on the RISC OS side if and only if a StrongARM is fitted, typically failing with data aborts on startup or shortly after booting, a hardware modification may be made to the StrongARM card to improve its timing synchronisation with the rest of the system.

If the card has not been modified and is still within warranty, then you should contact Acorn's Warranty department for instructions on how to return the card for modification; if the card is out of warranty and you do not have the SMT or antistatic capability to make the modifications yourself, you can contact Acorn's Warranty department to arrange an out-of-warranty repair. If you have access to SMT equipment and the training to use it, the changes are given below for information only; use this information to determine whether a card needs to be modified.

The changes are:

Locate resistors R25 and R35 on the CPU side of the StrongARM card. They should be mounted with their long axes perpendicular to the main connector on the card. Desolder them, and re-mount them on the same set of four pads with their main axes parallel to the card's main connector. As R25 and R35 have the same value, it is not important which resistor is mounted above which in the new arrangement. The unmodified and modified arrangements are illustrated in the figure below.

StrongARM Card (component side, ie side holding the processor)

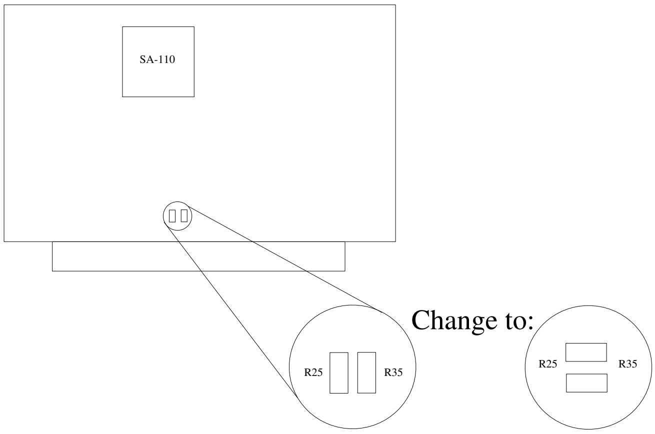

Figure 1: Location and configurations of R25 and R35 on the StrongARM Card

Our findings have shown us that this problem arises more frequently on Issue 1 and Issue 2 motherboards (those originally fitted with RISC OS 3.50 and which do not have 16 bit sound on the motherboard) than with Issue 3 boards; in any case, less than 5% of motherboards appear to be affected in this way.

What this change actually does is insert one more ACT08 gate in the path of the MCLK signal from the CPU card connector to the SA-110; this causes MCLK as seen by the StrongARM to be delayed by 4ns relative to the pre-modification MCLK. This delay is best thought of as a phase skew on MCLK as propagated to StrongARM in order to more closely align the rising edge of NCLK with the stable data area on the data bus.

Examination and Modification of PC Cards

The notes below refer to PC Cards fitted with Issue 2 of the Gemini ASIC, ie all cards other than the original 486SX/33 card (this latter card can be identified by the fact that it is fitted with a soldered-in TI 486SXL/40 chip, downclocked to 33MHz).

Following their initial release, it was found that some Gemini 2 PC cards could fail on boot-up from cold when partnered with highly-clocked ARM processors, especially when fitted to machines which had been significantly expanded in terms of RAM and podules; it was also possible for cards to hang an unpredictable and irreproducible time after booting. A small number of component changes were cut into production shortly after this was discovered, and so most PC cards today have already had these modifications made.

If the card has not been modified and is still within warranty, then you should contact Acorn's Warranty department for instructions on how to return the card for modification; if the card is out of warranty and you do not have the SMT capability to make the modifications yourself, you can contact Acorn's Warranty department to arrange an out-of-warranty repair. If you have access to SMT and antistatic equipment and the training to use it, the changes are given below for information only; use this information to determine whether a card needs to be modified.

The changes are:

R35 changes from 560R to 680R
C21 changes from 22pF to 0R0
R26 changes from 0R0 to 56R
C20 changes to 33uF 10V size C low ESR

These components can be found on the PC card as detailed below; you should be aware that not all the components have their identities screenprinted on the card or those identities may be obscured.

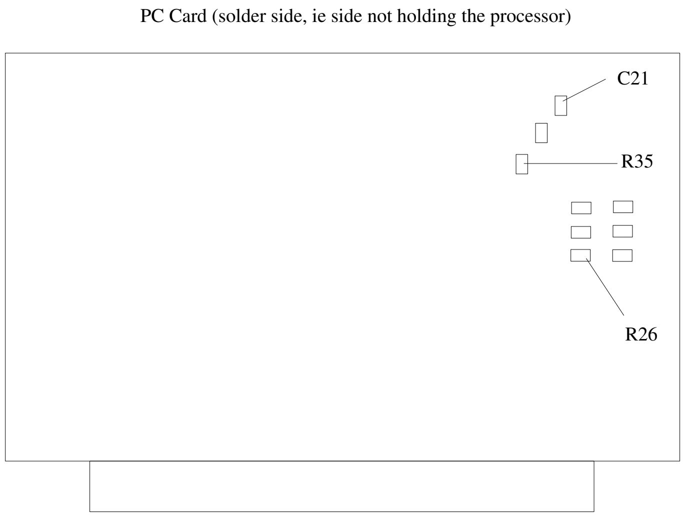

Figure 2: Location of C21, R26 and R35 on PC Card

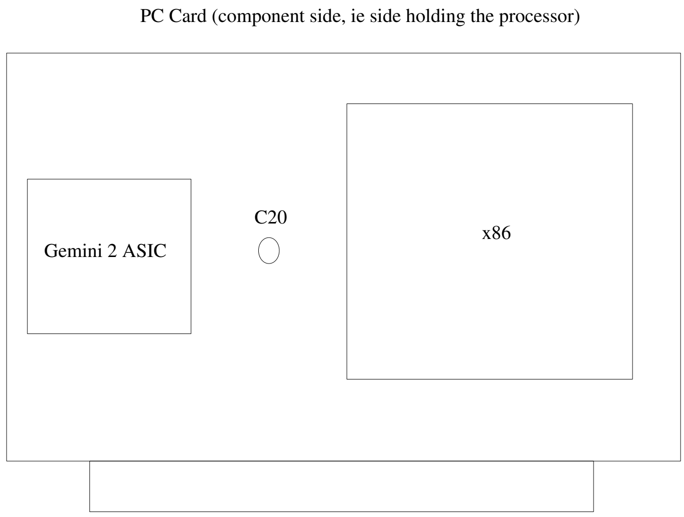

Figure 3: Location of C20 on PC Card

Soak-Testing PC Cards

Owing to the sensitivity of the Gemini 2 ASIC to the MCLK mark:space ratio, it is possible for a PC card to fail either on boot when the machine is started up from cold or some time into running; it is therefore necessary to give cards a good soak test (eg by leaving them running overnight) to determine whether any problems remain.

When soaking, it is strongly advised that any testing is done in the DOS environment or some equally low-level environment; use of Microsoft Windows during testing is **NOT** recommended (even though it can find evidence of hardware problems more quickly than DOS can), as errors in the installation or setup of this monolithic piece of software can generate errors which, even to the trained eye, are indistinguishable from errors generated as a result of hardware problems. Ideally, testing should be done using a PC partition on which Microsoft Windows has not been installed, and ART recommends the use of a DOS-based testing and diagnostic suite such as Norton.

If you do not have access to a suite such as Norton, the system can still be well exercised by leaving a DOS-based database or spreadsheet continuously sorting or recalculating. Testing by leaving one of the current crop of high-performance DOS-launched PC games running in self-play demo mode may also have some validity as a test; games such as Doom, Quake or others of their ilk will test most aspects of PC card operation (especially if left running in a window). However, it should be noted that transient hardware problems which occur when testing using a game may only show transient evidence of their existence, or if permanent evidence is retained it may be as subtle as the corruption of individual pixels on the display. In contrast, a PC Card hardware problem observed when running a spreadsheet or database usually results in either corupted cells or records, a complete interrupt lockout or a PC-side error which will halt the program.

If All Else Fails...

If following the procedures above still does not result in a fully working system, other modifications may still be made to solve the problem; however, the diagnosis required to troubleshoot a system which does not work after all appropriate measures described in this document have been applied goes beyond this document's scope.
You should contact ART directly (Tel +44 (0)1223 577800 and ask for Technical Support) so that we may discuss the situation further.