PERSISTOR
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Data Acquisition and Storage Solutions for Industry and Science

SiliconDrive Corruption and Exchange Notice

Persistor Instruments has identified two data corruption problems that can be made to occur when using power-cycling sleep modes (suspend for CF1/CF2, 3V sleep for CF8V2/AT8V2) with SiliconSystems SiliconDrive CF cards. Actual failures are quite rare with only two out of several hundred customers reporting any incident over the last two years. One of the card problems can be made to present repeatable deterministic failures under known conditions; and then made to uniformly stop failing with a simple software timing change. The other card problem affects only SiliconDrive CF cards having firmware associated with part number suffix 3005, but this problem is not so accommodating. We can force failures with a specific example, and make them stop with a software workaround, but we cannot create the kind of predictable and repeatable behaviors that would allow us to confirm the efficacy of a generic software fix, and the workaround itself requires what may be unacceptable compromises for some users. SiliconDrive CF cards with newer firmware and part number suffix 3100 or 3500 never exhibit this failure, and we are offering a limited time exchange program to allow affected and concerned customers to adopt this preemptive remedy. Persistor will swap out cards in warranty at no charge, and swap cards out of warranty at steeply discounted prices.

If you do not use and do not plan to use power-cycling sleep modes, you are not affected by these problems and may safely choose to ignore this notice. If you do use power-cycling sleep modes but are not seeing obvious file corruption problems, it's unlikely that you ever will. The next section describes the mechanics of the exchange and the following section contains additional technical information detailing the problems and remedies.

Card Exchange Eligibility and Procedures

Eligible Product: This notice is for SiliconSystems brand SiliconDrive CF cards, which have a Persistor Certified label with serial numbers between #18320 and #20701 inclusive. Some memory cards in this range are not SiliconSystems brand and are not being included.

Limited Time: The owner of the affected memory cards must submit the attached form by December 31, 2007. After that date Persistor will not be able to arrange for exchange of affected memory cards.

In Hand Ownership Whoever currently possesses an affected memory card may arrange for exchange directly with Persistor Instruments. They do not have to be channeled through intermediary owners or distributors. Please contact your customers about this exchange. Persistor has records only of the original sale.

Cards within warranty Affected memory cards purchased within the one-year warranty will be replaced by Persistor Instruments at no cost. The original card must be returned to Persistor Instruments in order to receive the free exchange.

Cards out of warranty Affected memory cards with expired one-year warranties may be replaced by Persistor Instruments at special discounted exchange pricing shown at right. The original card must be returned to Persistor Instruments in order to receive the discounted exchange.

Shipping The customer must pay the cost of returning cards to Persistor. Persistor will make ONE free shipment to the customer by Persistor's choice of delivery method. Any import taxes or customs fees for exchanges will be billed to the customer.

Part Number	Exchange Pricing
SSCF128MBI	$20
SSCF256MBI	$25
SSCF512MBI	$30
SSCF1GBI	$45
SSCF2GBI	$85
SSCF4GBI	$150
SSCF8GBI	$275

Unable to meet deadline If you cannot return memory cards before December 31, 2007, return the attached form (with a PO or credit card if necessary) explaining when you will be able to return the memory cards, and with your commitment to do so.

Multiple Returns will be accepted if necessary but shipping must be paid by the customer. Commitments for returns after December 31 must be made before that deadline.

Lead Time Exchanges may take up to 6 weeks.

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Qty	mem size	in warranty	out of warranty	serial number(s)	cost to exchange	extended cost
ORDER FORM TO EXCHANGE SILICONSYSTEMS MEMORY CARDS							
This form must be submitted by December 31, 2007							
		☐	☐			
		☐	☐			
		☐	☐			
		☐	☐			
		☐	☐			
		☐	☐			
		☐	☐			
					TOTAL before shipping	

SHIPPING CHOICE (Persistor will make ONE free shipment to the customer by Persistor's choice of delivery method, please allow 3-4 weeks for delivery to countries outside the United States.)

☐ **ONE free shipment at Persistor's expense**   ☐ **hold and ship with my next order**

☐ **Fedex Saver**   ☐ **fedex 2nd day**   ☐ **Fedex Intl Economy**   ☐ **Fedex Intl Priority**

SHIPPING INFORMATION

Name	Phone

Email

Address _____

_____

_____

_____

BILLING INFORMATION

Purchase Order Accepted with established credit

☐ **Visa** ☐ **Mastercard** ☐ **American Express**	**Exp date**

Credit card number

Credit card name

Attach additional pages if necessary. FAX form to 508-420-1656 and also send the form with the memory cards being replaced. *Exchanges will not be shipped until the original cards are returned.*

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Technical Information

Persistor Instruments has identified two data corruption problems that can be made to occur when using power-cycling sleep modes (suspend for CF1/CF2, 3V sleep for CF8V2/AT8V2) with SiliconSystems SiliconDrive CF cards. Actual failures are quite rare with only two out of several hundred customers reporting incidents over the last two years. One of the card problems can be made to present repeatable deterministic failures under known conditions; and then made to uniformly stop failing with a simple software timing change. The other card problem affects only SiliconDrive CF cards having firmware associated with part number suffix 3005, but this problem is not so accommodating. We can force failures with a specific example, and make them stop with a software workaround, but we cannot create the kind of predictable and repeatable behaviors that would allow us to confirm the efficacy of a generic software fix, and the workaround itself requires what may be unacceptable compromises for some users. SiliconDrive CF cards with newer firmware and part number suffix 3100 or 3500 never exhibit this failure, and we are offering a limited time exchange program to allow affected and concerned customers to adopt this preemptive remedy. Persistor will swap out cards in warranty at no charge, and swap cards out of warranty at steeply discounted prices.

Both card problems seem to relate to the way the SiliconDrive card internally manages the physical processes that translate sector based write requests to actual storage in the cards flash arrays. Under certain conditions and sequences, power-cycling shortly after discontiguous sector writes appears to interfere with that process causing lost data or data corruption. If you are not using or planning to use power-cycling sleep modes, you are not affected by these problems and may safely choose to ignore this notice. If you are using power-cycling sleep modes and not seeing obvious file corruption problems, it's unlikely that you ever will, and the limited time window for exchanges is the only matter requiring urgent attention. This section contains additional technical information detailing the problems and remedies.

Lost-sector problem

The lost-sector problem applies to both older and newer SiliconSystems SiliconDrive cards and it can result in loss of the data from the last sector written, but only if it is followed by a suspend cycle in less than 15ms, only if the sector is one of the first 256 sectors on the card, and only if preceded by a write to another discontiguous sector. If the problem occurs, the Persistor will resume from suspend to find the previously acknowledged as successfully written last sector may still contain the data pattern it held just prior to the last write. The lost-sector problem is easily prevented by inserting a 25ms delay in either PicoDOS or user software before initiating a power-cycling sleep operation. This remedy has been added to PicoDOS 4.03 for the CF1 and CF2, or can be added to your application for older versions of PicoDOS or for the CF8V2/AT8V2.

One customer was able to construct a program that sometimes triggered these conditions using standard file system operations, but that has been the only reported incident of this problem in actual practice. The resulting symptom was intermittent missing blocks of data, smaller than expected file sizes, and the apparent loss of free space on the card. In that customer example, the last sector written was the directory sector containing the file that was closed just prior to suspend. Though an entire sector was written, the only actual change was the 32-bit size value, so the times that the physical write failed to take, everything appeared normal except that the new length was not recorded and subsequent append mode opens began writing at the previous end and overwrote the latest data.

Test programs written for the CF2 to induce repeatable failures for analysis revealed the time and power decay rate dependencies as well as the effectiveness of the 25ms delay remedy. Tests with CF1, CF2, and CF8V2 products exhibited failures only within the first 256 sectors, while tests ported to another vendor's 80186 based SBC exhibited the failures and then had similar remedial effect with an added 25ms delay.

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Corrupted-block problem

The corrupted-block problem applies only to SiliconSystems SiliconDrive cards with the part number suffix 3005 and it can result in corruption of hundreds of near contiguous sectors following a suspend cycle after a poorly understood and very unusual confluence of writing patterns, sequences, and timings. If the problem occurs and corrupts the file system area of the card, the Persistor will resume from suspend with PicoDOS unable to successfully continue file operations until the card is reformatted. Corrupted-block failures are so rare, fragile, and elusive that we have not been able to discover its boundary conditions to devise any kind of verifiable generic software fix and leaving card replacement as an inconvenient but completely effective remedy.

The failure was discovered by an engineer from oceanographic instrumentation company who was able to create a failure generating demonstration program for the CF2 independent of custom hardware. His program was condensed from a field program that began to experience failures after the switch from SanDisk to SiliconSystems cards. The resultant standalone test program could usually trigger a corrupted-block failure within several hundred suspend cycles or about an hour in the most abbreviated form. The program essentially generates constant streams of data written to append mode files in odd value block sizes, punctuated by periods of suspend mode bracketed with fclose and (re)fopen, and with the streaming data operations occupying virtually all of the non-suspend time and generating many discontiguous reads and writes associated with append mode operation and odd value block sizes.

Eliminating the bracketing fclose before and (re)fopen after suspends also eliminates all of the failures in the test programs. Because closing a file implies rewriting the directory sector with updated size information, this suggests that discontiguous writes before the power-cycling plays a vital role allowing failures. However, this high-level remedy that focuses on a specific application's (albeit the only failing application) sequence of specific high-level file calls does not translate into a generic remedy that can be implemented at a lower level. The remedy also carries with it the risk that a program aborted while in suspend and not allowed to conclude would, on recovery, show zero length for the final file. Even though many writes may have concluded successfully, an operator would have to recognize and question the zero length final entry and use a specialized data recovery program to harvest the lost writes.

Though never exactly the same in position or content, corrupted regions stand out by manifesting themselves as contiguous blocks of up to 256 sectors containing inappropriate data patterns such as FFs, swaths of data from other areas of the card, or unreadable sectors with ECC errors. The inappropriate data patterns often contain recognizable patterns as portions of a FAT table or sequences of test patterns being written to the data areas, and the failures appear to be confined to areas where writing has taken place during the tests.

A failure of this type in the first 256 sectors would likely damage the partition table, DOS boot record, portions of one or both FATs, and possibly the root directory, any of which would result in the card becoming unmountable and causing file function requests to fail. Attempted data recovery in a PC would similarly fail to mount the card and more exhaustive recovery measures would require detailed knowledge of the starting condition of the card and file generation conventions of the controlling program, along with hints possibly embedded in the data files.

We have not been able to devise a mechanism for making the failures more frequent or more predictable and most changes actually decrease or stop the failures from occurring, but not in a verifiable way that inspires confidence or qualifies as a viable and generic remedy. However, in the hunt for answers to this problem, we did discover that we could not generate this failure with the newer SiliconSystems 3100 and 3500 series cards.

Although this problem has only been demonstrated by two out of several hundred Persistor users, and with over more than two years of extraordinarily trouble-free use of 3005 series cards, we recommend customers who use suspend mode on the CF1 or CF2, or 3V LPStop mode on the CF8V2, consider taking advantage of the limited time offer to exchange 3005 series cards for 3500 series cards.

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Questions & Answers

Q. ***How can we be sure the problems won't affect our systems?***
A. Both problems only happen during power-cycling sleep modes. If you don't use power-cycling sleep modes, you won't see the problem.

Q. ***If we've tested our systems thoroughly with the SiliconDrive cards mentioned and have not seen problems, what's the likelihood that we will be affected?***
A. We can't say with certainty; hence the exchange program, but with the amount of time these cards have been in use, and in the many varied remote data logging applications to which they're applied, and with only one confirmed CF2 program and one suspected CF8V2 card corruption, it would seem a highly unlikely probability.

Q. ***What are the power-cycling sleep modes for the CF1 and CF2 and how do I correct the lost-sector problem in software?***
A. PWRSuspendTicks, PWRSuspendSecs, and PWRSuspendUntil use power-cycling. LPStop and LPStopCSE do not. If you are using PicoDOS 4.03 or later, the delay is built-in and your software needs no changes. If you expect your programs to run on older versions, you should add the following code fragment in front of calls to the listed power-cycling functions. If the program also runs on newer PicoDOS systems, the doubled delay will cause no harm.

```
RTCDelayMicroSeconds(25000);      // Delay 25ms before suspend
```

Q. ***What are the power-cycling sleep modes for the CF8V2 and AT8V2?***
A. Power-cycling for the V2 systems affects only the flash card circuitry. It happens automatically in the V2 hardware whenever signal SEL5V goes low as part of a user function (often derived from the Onset LPSleep or NewSleep example code and the LowPowerSleep function which references VRegSelect or VRegSwitchTo called with the argument set to v3) to implement the lowest power sleep strategy. PicoDOS automatically repowers the card whenever a card operation is requested. PicoDOS8.h also allows the card power to be manually controlled using the V2CardPower(on or off) macro to implement custom power-cycling. It would be prudent to assume that explicit use of this could generate the types of failures discussed in this notice.

```
DelayMilliSecs(25); // Delay 25ms before 3V VRegSelect, VRegSwitchTo, and LowPowerSleep
```

Q. ***Can automatic power-cycling at 3V sleep be disabled in software for the CF8V2 and AT8V2?***
A. No, it happens in hardware when SEL5V goes low. You can choose 5V sleep and no automatic power-cycling will occur.

Q. ***What are the power-cycling sleep modes for the classic CF8 and AT8?***
A. The classic CF8 and AT8 do not use power-cycling sleep modes.

Q. ***What are the differences between 3005 and 3500 suffix cards?***
A. In addition to newer firmware that eliminates the 3005 corruption issue, the 3500 firmware provides for new capabilities and the cards themselves are built with lead-free components that allow them to claim RoHS 6 of 6 compliance. The 3500 cards seem to exhibit roughly equivalent speeds as same sized 3005 cards when written in large (>=16KB) blocks, but about 3% slower when written in small blocks.

Q. ***Why not switch to a different card vendor to fix the problems?***
A. We actually did reevaluate the latest industrial grade card offerings from several manufacturers in the pursuit of understanding this problem. Though no other brands exhibited these problems, no other vendor has demonstrated the level of commitment to the industrial grade market that is easily seen from a visit to www.siliconsystems.com and review of their technical publications. These two problems aside, the previous two years experience with SiliconSystems cards mated to our products have been the most trouble free in our company's ten-year history. During all that time, we have tested every card that bears the PII certified label, and we have never seen better continuity and quality levels with other brands. We will continue to recommend SiliconSystems cards for use with our products.

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Q. ***What is the compromise associated with the corrupted-block software fix?***
A. Aside from it not being generic as described earlier, elimination of fclose-(re)fopen operations that were presumably included to increase data recovery reliability introduces another level of risk and increases the effort required to ensure that users look for anomalies (i.e zero length files) to make sure that all data that can be recovered actually is.

Q. ***How much testing has been done on CF8V2/AT8V2 devices?***
A. We have confirmed the lost-sector problem and remedy on the CF8V2. We have not attempted to replicate the corrupted-block failure on the CF8V2 and have no plans to. We added the CF8V2 customers to the exchange program as a preemptive measure after receiving a single 3005 card from a CF8V2 user that showed failure patterns similar to the corrupted-block failure on the CF2. We have done no testing with the AT8V2 but its hardware is identical to the CF8V2 with the exception of the connectors for PCMCIA cards, and we are taking the same preemptive card swap action with the 3005 firmware PCMCIA cards.