

**NAME**

am9513 – PC board timer/counters based on the AMD Am9513 chip

**DESCRIPTION**

The Advanced Micro Devices Am9513 System Timing Controller chip (and compatible chips) are used in counter/timer ISA and PCI cards from a number of vendors, including the Measurement Computing (formerly ComputerBoards) CIO-CTR05/10/20 ISA cards, the Keithley-Metrabyte Model CTM-05/10 ISA cards, the Scientific Solutions Labmaster series ISA and PCI cards, the Kontron PCIDCC5/20-P PCI cards and similar models from other manufacturers. (Note: the Measurement Computing PCI-CTR05 card has a design flaw that makes it unsuitable for use with `spec` as a monitor-preset counter. The PCI IDs of that card will be recognized by `spec`, and the card can be used to count to a time preset, but is not recommended due to the limited functionality.)

The Am9513 chip contains five 16-bit counters that can be programmed in a wide range of configurations. Although boards may contain more than one of the chips, the first chip on the timer/counter board is used as the master timer. `spec`'s programming uses two of the counters of the master timer for a 32-bit detector counter, two for a 32-bit monitor counter and one for a 16-bit elapsed time counter. On boards with two or four chips, the additional chips are each programmed for two more 32-bit detector counters. You can program the chip through `spec` to count to either a time preset using the `tcount()` function or a monitor-count preset using `mcount()`.

Note, `spec` release 5.06.03 includes several updates to the Am9513 support. With the update, more than one Am9513-type card can be configured at a time, where the additional cards must be configured as counters only. Also, the code was changed to improve the timer gating, although an additional jumper is required to make the change effective. Previously, the timer was started in one instruction, followed by another instruction that released the gate signal that inhibited the counters. In the new code, the timer will also be gated by the gate signal, but only if the additional jumper from *output 1* to *gate 1* is installed. (See the **HARDWARE CONFIGURATION** section below). `spec` will test for the presence of the additional jumper. If it is missing, `spec` will program the timer for no gate, as before, and print a message suggesting the jumper be added.

**SOFTWARE CONFIGURATION**

Use `spec`'s configuration editor (`edconf`, normally invoked by the `config` macro) to select the timer and to configure the scaler channels. For ISA cards, enter the base address on the *Device* screen. For all cards, enter the number of counters to be used on the board:

SCALERS	DEV	ADDR	<>MODE	NUM	<>TYPE
YES		0x340		3	Am9513 Counter/Timer ISA Boards
YES				3	Am9513 Counter/Timer PCI Boards
YES		0x340		2	Am9513 Counter-Only ISA Boards
YES				2	Am9513 Counter-Only PCI Boards

Note that for the Labmaster board, the base address of the counter chip is eight plus the base address of the board itself. For PCI cards, the address is determined automatically.

For each additional chip on a board, add 2 to the value in the `NUM` field.

If more than one PCI Am9513 board is installed, the unit numbers are assigned to the boards, starting with unit 0, in the same order as the PCI bus/slot/function IDs are assigned by the computer. (The `Linux` command `/sbin/lspci` lists the PCI identifiers.)

As of `spec` release 5.06.03, the command

```
counter_par(mne, "device_id")
```

where `mne` is the mnemonic of a counter associated with a PCI Am9513 card, will return a string containing the I/O base address of the PCI counter/timer cards, which may useful in

writing macros that access other features of the card, such as digital I/O, A/D converters, etc.

On the *Scaler* screen, the channel assignments must have the timebase as channel 0 and the monitor as channel 1, as shown below.

NUMBER	NAME	MNEMONIC	<>DEVICE	UNIT	CHAN	<>USE AS	SCALE
0	Seconds	sec	AM9513	0	0	timebase	1
1	Monitor	mon	AM9513	0	1	monitor	1
2	Detector	det	AM9513	0	2	counter	1
3	Counter 2	cnt2	AM9513	0	3	counter	1
4	Counter 3	cnt3	AM9513	0	4	counter	1
5	Counter 4	cnt4	AM9513	1	0	counter	1
6	Counter 5	cnt5	AM9513	1	1	counter	1

The timebase scale factor is ignored. Counters on unit 0, channels 3 and 4 would only be available if there are at least two Am9513 chips on the card. Counters on unit 1 correspond to a second Am9513 card.

### HARDWARE CONFIGURATION

Connect the detector to the input connector pin labeled *source 3*. Counts received from the monitor go to the pin labeled *source 5*. In addition, wire the connector pin labeled *output 1* to the pins *gate 1*, *gate 2*, *gate 4* and *gate 5*. (In the more recent Keithley-Metrabyte CTM-05A manual, the *source* pins are now labeled *ACLKIN*, the *output* pins are now labeled *ATIMER-OUT*, and the *gate* pins are now labeled *AGATE*.)

For a two- or four-chip board, or for additional counter-only boards, additional detectors can be connected to the *source 3* and *source 5* pins of the chips. In addition, the *output 1* from the first chip of the timer/counter board must be connected to *gate 2* and *gate 4* of the additional chips.

The counter boards are accessed from user level and are polled to determine when count intervals have elapsed. Thus, interrupts should be disabled on the boards.

When counting to time, the resolution of the clock depends on the length of the count interval. The maximum count time is 71.5 minutes. The time base resolution (in seconds) is set according to the following table:

0.00001	for $t < 0.6$ sec
0.0001	for $t < 6$ sec
0.001	for $t < 60$ sec
0.01	for $t < 655.35$ sec (10.9 min)
0.0655	for $t < 71.5$ min

When counting to monitor counts, the 0.01 second time base is used, and the value returned for the time channel will be corrected to account for the rollovers that occur every 655.36 seconds.