



## ***Rocky Enterprise Linux 9.2 Manual Pages on command 'sigaction.2'***

### **C:\>man sigaction.2**

SIGACTION(2)                      Linux Programmer's Manual                      SIGACTION(2)

#### NAME

sigaction, rt\_sigaction - examine and change a signal action

#### SYNOPSIS

```
#include <signal.h>
```

```
int sigaction(int signum, const struct sigaction *act,  
              struct sigaction *oldact);
```

Feature Test Macro Requirements for glibc (see `feature_test_macros(7)`):

```
sigaction(): _POSIX_C_SOURCE
```

```
siginfo_t: _POSIX_C_SOURCE >= 199309L
```

#### DESCRIPTION

The `sigaction()` system call is used to change the action taken by a process on receipt of a specific signal. (See `signal(7)` for an overview of signals.)

`signum` specifies the signal and can be any valid signal except `SIGKILL` and `SIGSTOP`.

If `act` is non-NULL, the new action for signal `signum` is installed from `act`. If

`oldact` is non-NULL, the previous action is saved in `oldact`.

The `sigaction` structure is defined as something like:

```
struct sigaction {  
    void (*sa_handler)(int);  
    void (*sa_sigaction)(int, siginfo_t *, void *);  
    sigset_t sa_mask;  
    int sa_flags;
```

```
void (*sa_restorer)(void);  
};
```

On some architectures a union is involved: do not assign to both `sa_handler` and `sa_sigaction`.

The `sa_restorer` field is not intended for application use. (POSIX does not specify a `sa_restorer` field.) Some further details of the purpose of this field can be found in `sigreturn(2)`.

`sa_handler` specifies the action to be associated with `signum` and may be `SIG_DFL` for the default action, `SIG_IGN` to ignore this signal, or a pointer to a signal handling function. This function receives the signal number as its only argument.

If `SA_SIGINFO` is specified in `sa_flags`, then `sa_sigaction` (instead of `sa_handler`) specifies the signal-handling function for `signum`. This function receives three arguments, as described below.

`sa_mask` specifies a mask of signals which should be blocked (i.e., added to the signal mask of the thread in which the signal handler is invoked) during execution of the signal handler. In addition, the signal which triggered the handler will be blocked, unless the `SA_NODEFER` flag is used.

`sa_flags` specifies a set of flags which modify the behavior of the signal. It is formed by the bitwise OR of zero or more of the following:

#### `SA_NOCLDSTOP`

If `signum` is `SIGCHLD`, do not receive notification when child processes stop (i.e., when they receive one of `SIGSTOP`, `SIGTSTP`, `SIGTTIN`, or `SIGTTOU`) or resume (i.e., they receive `SIGCONT`) (see `wait(2)`). This flag is meaningful only when establishing a handler for `SIGCHLD`.

#### `SA_NOCLDWAIT` (since Linux 2.6)

If `signum` is `SIGCHLD`, do not transform children into zombies when they terminate. See also `waitpid(2)`. This flag is meaningful only when establishing a handler for `SIGCHLD`, or when setting that signal's disposition to `SIG_DFL`.

If the `SA_NOCLDWAIT` flag is set when establishing a handler for `SIGCHLD`, POSIX.1 leaves it unspecified whether a `SIGCHLD` signal is generated when a child process terminates. On Linux, a `SIGCHLD` signal is generated in this case; on some other implementations, it is not.

## SA\_NODEFER

Do not prevent the signal from being received from within its own signal handler. This flag is meaningful only when establishing a signal handler. SA\_NOMASK is an obsolete, nonstandard synonym for this flag.

## SA\_ONSTACK

Call the signal handler on an alternate signal stack provided by `sigaltstack(2)`. If an alternate stack is not available, the default stack will be used. This flag is meaningful only when establishing a signal handler.

## SA\_RESETHAND

Restore the signal action to the default upon entry to the signal handler. This flag is meaningful only when establishing a signal handler. SA\_ONESHOT is an obsolete, nonstandard synonym for this flag.

## SA\_RESTART

Provide behavior compatible with BSD signal semantics by making certain system calls restartable across signals. This flag is meaningful only when establishing a signal handler. See `signal(7)` for a discussion of system call restarting.

## SA\_RESTORER

Not intended for application use. This flag is used by C libraries to indicate that the `sa_restorer` field contains the address of a "signal trampoline". See `sigreturn(2)` for more details.

## SA\_SIGINFO (since Linux 2.2)

The signal handler takes three arguments, not one. In this case, `sa_sigaction` should be set instead of `sa_handler`. This flag is meaningful only when establishing a signal handler.

The `siginfo_t` argument to a SA\_SIGINFO handler

When the SA\_SIGINFO flag is specified in `act.sa_flags`, the signal handler address is passed via the `act.sa_sigaction` field. This handler takes three arguments, as follows:

```
void  
handler(int sig, siginfo_t *info, void *ucontext)
```

```
{
```

```
...
}
```

These three arguments are as follows

**sig** The number of the signal that caused invocation of the handler.

**info** A pointer to a `siginfo_t`, which is a structure containing further information about the signal, as described below.

**ucontext**

This is a pointer to a `ucontext_t` structure, cast to `void *`. The structure pointed to by this field contains signal context information that was saved on the user-space stack by the kernel; for details, see `sigreturn(2)`. Further information about the `ucontext_t` structure can be found in `getcontext(3)`. Commonly, the handler function doesn't make any use of the third argument.

The `siginfo_t` data type is a structure with the following fields:

```
siginfo_t {
    int    si_signo; /* Signal number */
    int    si_errno; /* An errno value */
    int    si_code; /* Signal code */
    int    si_trapno; /* Trap number that caused
                       hardware-generated signal
                       (unused on most architectures) */
    pid_t  si_pid; /* Sending process ID */
    uid_t  si_uid; /* Real user ID of sending process */
    int    si_status; /* Exit value or signal */
    clock_t si_utime; /* User time consumed */
    clock_t si_stime; /* System time consumed */
    sigval_t si_value; /* Signal value */
    int    si_int; /* POSIX.1b signal */
    void *si_ptr; /* POSIX.1b signal */
    int    si_overrun; /* Timer overrun count;
                       POSIX.1b timers */
    int    si_timerid; /* Timer ID; POSIX.1b timers */
    void *si_addr; /* Memory location which caused fault */
}
```

```

long    si_band;    /* Band event (was int in
                    glibc 2.3.2 and earlier) */
int     si_fd;     /* File descriptor */
short   si_addr_lsb; /* Least significant bit of address
                    (since Linux 2.6.32) */
void    *si_lower; /* Lower bound when address violation
                    occurred (since Linux 3.19) */
void    *si_upper; /* Upper bound when address violation
                    occurred (since Linux 3.19) */
int     si_pkey;   /* Protection key on PTE that caused
                    fault (since Linux 4.6) */
void    *si_call_addr; /* Address of system call instruction
                    (since Linux 3.5) */
int     si_syscall; /* Number of attempted system call
                    (since Linux 3.5) */
unsigned int si_arch; /* Architecture of attempted system call
                    (since Linux 3.5) */
}

```

si\_signo, si\_errno and si\_code are defined for all signals. (si\_errno is generally unused on Linux.) The rest of the struct may be a union, so that one should read only the fields that are meaningful for the given signal:

\* Signals sent with kill(2) and sigqueue(3) fill in si\_pid and si\_uid. In addition, signals sent with sigqueue(3) fill in si\_int and si\_ptr with the values specified by the sender of the signal; see sigqueue(3) for more details.

\* Signals sent by POSIX.1b timers (since Linux 2.6) fill in si\_overrun and si\_timerid. The si\_timerid field is an internal ID used by the kernel to identify the timer; it is not the same as the timer ID returned by timer\_create(2). The si\_overrun field is the timer overrun count; this is the same information as is obtained by a call to timer\_getoverrun(2). These fields are nonstandard Linux extensions.

\* Signals sent for message queue notification (see the description of SIGEV\_SIGNAL in mq\_notify(3)) fill in si\_int/si\_ptr, with the sigev\_value supplied to mq\_notify(3); si\_pid, with the process ID of the message sender; and si\_uid, with the

real user ID of the message sender.

\* SIGCHLD fills in `si_pid`, `si_uid`, `si_status`, `si_utime`, and `si_stime`, providing information about the child. The `si_pid` field is the process ID of the child; `si_uid` is the child's real user ID. The `si_status` field contains the exit status of the child (if `si_code` is `CLD_EXITED`), or the signal number that caused the process to change state. The `si_utime` and `si_stime` contain the user and system CPU time used by the child process; these fields do not include the times used by waited-for children (unlike `getrusage(2)` and `times(2)`). In kernels up to 2.6, and since 2.6.27, these fields report CPU time in units of `sysconf(_SC_CLK_TCK)`. In 2.6 kernels before 2.6.27, a bug meant that these fields reported time in units of the (configurable) system jiffy (see `time(7)`).

\* SIGILL, SIGFPE, SIGSEGV, SIGBUS, and SIGTRAP fill in `si_addr` with the address of the fault. On some architectures, these signals also fill in the `si_trapno` field.

Some suberrors of SIGBUS, in particular `BUS_MCEERR_AO` and `BUS_MCEERR_AR`, also fill in `si_addr_lsb`. This field indicates the least significant bit of the reported address and therefore the extent of the corruption. For example, if a full page was corrupted, `si_addr_lsb` contains `log2(sysconf(_SC_PAGESIZE))`. When SIGTRAP is delivered in response to a `ptrace(2)` event (`PTRACE_EVENT_foo`), `si_addr` is not populated, but `si_pid` and `si_uid` are populated with the respective process ID and user ID responsible for delivering the trap. In the case of `seccomp(2)`, the tracee will be shown as delivering the event. `BUS_MCEERR_*` and `si_addr_lsb` are Linux-specific extensions.

The `SEGV_BNDERR` suberror of SIGSEGV populates `si_lower` and `si_upper`.

The `SEGV_PKUERR` suberror of SIGSEGV populates `si_pkey`.

\* SIGIO/SIGPOLL (the two names are synonyms on Linux) fills in `si_band` and `si_fd`.

The `si_band` event is a bit mask containing the same values as are filled in the `revents` field by `poll(2)`. The `si_fd` field indicates the file descriptor for which the I/O event occurred; for further details, see the description of `F_SETSIG` in `fcntl(2)`.

\* SIGSYS, generated (since Linux 3.5) when a `seccomp` filter returns `SECURITY_ERR`, fills in `si_call_addr`, `si_syscall`, `si_arch`, `si_errno`, and other fields as described in `seccomp(2)`.

## The si\_code field

The si\_code field inside the siginfo\_t argument that is passed to a SA\_SIGINFO signal handler is a value (not a bit mask) indicating why this signal was sent. For a ptrace(2) event, si\_code will contain SIGTRAP and have the ptrace event in the high byte:

(SIGTRAP | PTRACE\_EVENT\_foo << 8).

For a non-ptrace(2) event, the values that can appear in si\_code are described in the remainder of this section. Since glibc 2.20, the definitions of most of these symbols are obtained from <signal.h> by defining feature test macros (before including any header file) as follows:

- \* \_XOPEN\_SOURCE with the value 500 or greater;
- \* \_XOPEN\_SOURCE and \_XOPEN\_SOURCE\_EXTENDED; or
- \* \_POSIX\_C\_SOURCE with the value 200809L or greater.

For the TRAP\_\* constants, the symbol definitions are provided only in the first two cases. Before glibc 2.20, no feature test macros were required to obtain these symbols.

For a regular signal, the following list shows the values which can be placed in si\_code for any signal, along with the reason that the signal was generated.

### SI\_USER

kill(2).

### SI\_KERNEL

Sent by the kernel.

### SI\_QUEUE

sigqueue(3).

### SI\_TIMER

POSIX timer expired.

### SI\_MESGQ (since Linux 2.6.6)

POSIX message queue state changed; see mq\_notify(3).

### SI\_ASYNCIO

AIO completed.

### SI\_SIGIO

Queued SIGIO (only in kernels up to Linux 2.2; from Linux 2.4 onward SIGIO/SIGPOLL fills in si\_code as described below).

SI\_TKILL (since Linux 2.4.19)

tkill(2) or tkill(2).

The following values can be placed in si\_code for a SIGILL signal:

ILL\_ILLOPC

Illegal opcode.

ILL\_ILLOPN

Illegal operand.

ILL\_ILLADR

Illegal addressing mode.

ILL\_ILLTRP

Illegal trap.

ILL\_PRVOPC

Privileged opcode.

ILL\_PRVREG

Privileged register.

ILL\_COPROC

Coprocessor error.

ILL\_BADSTK

Internal stack error.

The following values can be placed in si\_code for a SIGFPE signal:

FPE\_INTDIV

Integer divide by zero.

FPE\_INTOVF

Integer overflow.

FPE\_FLTDIV

Floating-point divide by zero.

FPE\_FLTOVF

Floating-point overflow.

FPE\_FLTUND

Floating-point underflow.

FPE\_FLTRES

Floating-point inexact result.

FPE\_FLTINV

Floating-point invalid operation.

FPE\_FLTSUB

Subscript out of range.

The following values can be placed in `si_code` for a SIGSEGV signal:

SEGV\_MAPERR

Address not mapped to object.

SEGV\_ACCERR

Invalid permissions for mapped object.

SEGV\_BNDERR (since Linux 3.19)

Failed address bound checks.

SEGV\_PKUERR (since Linux 4.6)

Access was denied by memory protection keys. See `pkeys(7)`. The protection key which applied to this access is available via `si_pkey`.

The following values can be placed in `si_code` for a SIGBUS signal:

BUS\_ADRALN

Invalid address alignment.

BUS\_ADRERR

Nonexistent physical address.

BUS\_OBJERR

Object-specific hardware error.

BUS\_MCEERR\_AR (since Linux 2.6.32)

Hardware memory error consumed on a machine check; action required.

BUS\_MCEERR\_AO (since Linux 2.6.32)

Hardware memory error detected in process but not consumed; action optional.

The following values can be placed in `si_code` for a SIGTRAP signal:

TRAP\_BRKPT

Process breakpoint.

TRAP\_TRACE

Process trace trap.

TRAP\_BRANCH (since Linux 2.4, IA64 only))

Process taken branch trap.

TRAP\_HWBKPT (since Linux 2.4, IA64 only))

Hardware breakpoint/watchpoint.

The following values can be placed in `si_code` for a SIGCHLD signal:

CLD\_EXITED

Child has exited.

CLD\_KILLED

Child was killed.

CLD\_DUMPED

Child terminated abnormally.

CLD\_TRAPPED

Traced child has trapped.

CLD\_STOPPED

Child has stopped.

CLD\_CONTINUED (since Linux 2.6.9)

Stopped child has continued.

The following values can be placed in `si_code` for a SIGIO/SIGPOLL signal:

POLL\_IN

Data input available.

POLL\_OUT

Output buffers available.

POLL\_MSG

Input message available.

POLL\_ERR

I/O error.

POLL\_PRI

High priority input available.

POLL\_HUP

Device disconnected.

The following value can be placed in `si_code` for a SIGSYS signal:

SYS\_SECCOMP (since Linux 3.5)

Triggered by a seccomp(2) filter rule.

## RETURN VALUE

`sigaction()` returns 0 on success; on error, -1 is returned, and `errno` is set to in?

dicatate the error.

## ERRORS

`EFAULT` act or oldact points to memory which is not a valid part of the process address space.

`EINVAL` An invalid signal was specified. This will also be generated if an attempt is made to change the action for `SIGKILL` or `SIGSTOP`, which cannot be caught or ignored.

## CONFORMING TO

POSIX.1-2001, POSIX.1-2008, SVr4.

## NOTES

A child created via `fork(2)` inherits a copy of its parent's signal dispositions.

During an `execve(2)`, the dispositions of handled signals are reset to the default; the dispositions of ignored signals are left unchanged.

According to POSIX, the behavior of a process is undefined after it ignores a `SIGFPE`, `SIGILL`, or `SIGSEGV` signal that was not generated by `kill(2)` or `raise(3)`.

Integer division by zero has undefined result. On some architectures it will generate a `SIGFPE` signal. (Also dividing the most negative integer by -1 may generate `SIGFPE`.) Ignoring this signal might lead to an endless loop.

POSIX.1-1990 disallowed setting the action for `SIGCHLD` to `SIG_IGN`. POSIX.1-2001 and later allow this possibility, so that ignoring `SIGCHLD` can be used to prevent the creation of zombies (see `wait(2)`). Nevertheless, the historical BSD and System V behaviors for ignoring `SIGCHLD` differ, so that the only completely portable method of ensuring that terminated children do not become zombies is to catch the `SIGCHLD` signal and perform a `wait(2)` or similar.

POSIX.1-1990 specified only `SA_NOCLDSTOP`. POSIX.1-2001 added `SA_NOCLDSTOP`, `SA_NOCLDWAIT`, `SA_NODEFER`, `SA_ONSTACK`, `SA_RESETHAND`, `SA_RESTART`, and `SA_SIGINFO`. Use of these latter values in `sa_flags` may be less portable in applications intended for older UNIX implementations.

The `SA_RESETHAND` flag is compatible with the SVr4 flag of the same name.

The `SA_NODEFER` flag is compatible with the SVr4 flag of the same name under kernels 1.3.9 and newer. On older kernels the Linux implementation allowed the receipt of any signal, not just the one we are installing (effectively overriding any `sa_mask` settings).

`sigaction()` can be called with a `NULL` second argument to query the current signal

handler. It can also be used to check whether a given signal is valid for the current machine by calling it with NULL second and third arguments.

It is not possible to block SIGKILL or SIGSTOP (by specifying them in `sa_mask`). Attempts to do so are silently ignored.

See `sigsetops(3)` for details on manipulating signal sets.

See `signal-safety(7)` for a list of the `async-signal-safe` functions that can be safely called inside from inside a signal handler.

## C library/kernel differences

The `glibc` wrapper function for `sigaction()` gives an error (`EINVAL`) on attempts to change the disposition of the two real-time signals used internally by the `NPTL` threading implementation. See `nptl(7)` for details.

On architectures where the signal trampoline resides in the C library, the `glibc` wrapper function for `sigaction()` places the address of the trampoline code in the `act.sa_restorer` field and sets the `SA_RESTORER` flag in the `act.sa_flags` field. See `sigreturn(2)`.

The original Linux system call was named `sigaction()`. However, with the addition of real-time signals in Linux 2.2, the fixed-size, 32-bit `sigset_t` type supported by that system call was no longer fit for purpose. Consequently, a new system call, `rt_sigaction()`, was added to support an enlarged `sigset_t` type. The new system call takes a fourth argument, `size_t sigsetsize`, which specifies the size in bytes of the signal sets in `act.sa_mask` and `oldact.sa_mask`. This argument is currently required to have the value `sizeof(sigset_t)` (or the error `EINVAL` results).

The `glibc` `sigaction()` wrapper function hides these details from us, transparently calling `rt_sigaction()` when the kernel provides it.

## Undocumented

Before the introduction of `SA_SIGINFO`, it was also possible to get some additional information about the signal. This was done by providing an `sa_handler` signal handler with a second argument of type `struct sigcontext`, which is the same structure as the one that is passed in the `uc_mcontext` field of the `ucontext` structure that is passed (via a pointer) in the third argument of the `sa_sigaction` handler. See the relevant Linux kernel sources for details. This use is obsolete now.

## BUGS

In kernels up to and including 2.6.13, specifying `SA_NODEFER` in `sa_flags` prevents

not only the delivered signal from being masked during execution of the handler, but also the signals specified in `sa_mask`. This bug was fixed in kernel 2.6.14.

#### EXAMPLE

See `mprotect(2)`.

#### SEE ALSO

`kill(1)`, `kill(2)`, `pause(2)`, `pidfd_send_signal(2)`, `restart_syscall(2)`, `seccomp(2)`, `sigaltstack(2)`, `signal(2)`, `signalfd(2)`, `sigpending(2)`, `sigprocmask(2)`, `sigre?turn(2)`, `sigsuspend(2)`, `wait(2)`, `killpg(3)`, `raise(3)`, `siginterrupt(3)`, `sigqueue(3)`, `sigsetops(3)`, `sigvec(3)`, `core(5)`, `signal(7)`

#### COLOPHON

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2019-10-10

SIGACTION(2)