

# MBARI Carbon WG Console Help

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## General syntax guidelines

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The guiding principles for syntax and semantic design in the user interface (UI) include:

- simplicity (easy to type and understand)
- human- and machine-friendly
- balance minimal command length with readability
- structural and behavioral consistency
- one good way to do anything : full, fine-grained functional exposure with minimal redundancy
- economic with system resources

To that end, these conventions are used:

- `<foo>` indicates an option named foo, which has yet to be defined
- In the context of a command line use note, arguments in square brackets e.g. `[ <foo> <bar> ]` are optional but may contain required elements. For example `[op <var>]` indicates that you may use `'op <var>'` but not just `'op'` or `'<var>'`
- In the context of command notes, options in square brackets may indicate set of literal values `[<xn|*]` or `[=,-,++,+=,-.=,*=,/=,%=]`
- Options with ellipses `'...'` indicates that the preceding option may be repeated e.g., `[<foo>...]` means one or more `<foo>` options
- Options don't use dashes (H not -H)
- Except where it is ambiguous, there is no space between option arguments and values e.g. `x1.23, F003`
- A colon is used to disambiguate options and arguments; e.g. a command has options S and S2 with numeric values - `S:123 S2:1.34`
- A colon is used to delimit multi-valued options (i.e. a list), which are comma-delimited e.g. `out:cr,pdh`
- If an option list contains multi-valued variables (sub-list), the sub-list is delimited using `'/'`, e.g. `shl:v1a/v3,5000`
- `*` is a wildcard, signifying all/any

# Topic APP\_EX

(pCO<sub>2</sub>/DIC experiment)

---

Application specific : Measurement control macros tailored to control pCO<sub>2</sub> and DIC measurements using LI-COR gas analyzer.

---

## About MDIO and MMEAS APIs

MDIO and MMEAS separate IO manipulation from measurement processing.

MDIO may be used to set up valves and pumps with precision timing (~10 ms resolution). MMEAS is used to process a set of LI-COR measurements, using specified parameters and timing.

They provide fine-grained and flexible control of measurement operations, including macros that encapsulate multiple operations and their parameters, with minimal parameter overrides.

MDIO includes a compact syntax for composing IO sequences.

MMEAS uses a measurement profile buffer that persists between calls (the operation profile); this buffer is always used when executing a measurement.

There are a set of user-defined profile buffers, and read-only preset profiles. The USR and LOAD (or TS) MMEAS options are used to initialize the operation profile, apply optional overrides, and/or inspect the configuration before performing the measurement.

The TS (take sample) option automatically runs specified profiles after any options are processed.

The LOAD option requires the RUN option, e.g.

```
ts:air,b2000
```

is equivalent to

```
load:air,b2000,run
```

## MDIO

```
use      : MDIO [ options... ]

brief    : Assert digital IO and macros w/ optional delay between operations.
           Multiple options may be provided.

Options:
```

|          |                                                                                                               |
|----------|---------------------------------------------------------------------------------------------------------------|
| <macro>  | - Run macro (commonly used IO sequences, see notes)                                                           |
| <preset> | - Actuate pre-defined valve sets or pumps (see notes)                                                         |
| PHL, PLH | - pulse IO bit(s) HI/LO, LO/HI (multiple cycles, e.g. pump)<br>use: phl:<iobits,ton,toff,cycles,[post-delay]> |
| SHL, SLH | - pulse IO bit(s) HI/LO, LO/HI (single cycle, toff=0 e.g. valve)<br>use: shl:<iobits,ton,[post-delay]>        |
| IOH, IOL | - set IO bit(s) HI/LO (i.e. ON/OFF)<br>use: ioh:<iobits,[post-delay]>                                         |
| D        | - delay for specified time (msec)<br>use: d<n> (e.g. d5000) or d\$cx<n> (e.g. d\$cx3)                         |
| PT       | - preset valve pulse time (msec)<br>Applies only to IO presets<br>use: pt<n> (e.g. vt200)                     |
| PH       | - preset pump pulse ton (msec)<br>Applies only to IO presets<br>use: ph<n> (e.g. ph200)                       |
| PL       | - preset pump pulse toff (msec)<br>Applies only to IO presets<br>use: pl<n> (e.g. pl300)                      |
| PN       | - preset pump pulse cycles<br>Applies only to IO presets<br>use: pn<n> (e.g. pn15)                            |
| MT       | - macro valve pulse time (msec)<br>Applies only to macros<br>use: mt<n> (e.g. mt100)                          |
| MH       | - macro pump pulse ton (msec)<br>Applies only to macros<br>use: mh<n> (e.g. mh150)                            |
| ML       | - macro pump pulse toff (msec)<br>Applies only to macros<br>use: ml<n> (e.g. ml300)                           |
| MN       | - macro pump pulse cycles<br>Applies only to macros<br>use: mn<n> (e.g. mn20)                                 |
| +V,-V    | - enable/disable verbose output                                                                               |
| SHOW     | - show state and preset/macro names                                                                           |

where:

```
iobits      - IO bits (use SET BITS syntax, separated by '/')
ton         - pulse ON time (msec)
toff        - pulse OFF time (msec)
cycles      - pulse cycles
post-delay  - post-operation delay (msec)
<n>         - integer number
```

## <preset> Values (IO Presets) [2]:

```
+/-AIR      - air pump on/off
+/-SEA      - seawater pump on/off
+/-LI       - LI-COR power on/off
+/-UL       - LI-COR UART enable on/off
APUMP       - run acid pump
SPUMP       - run spump
+/-IOPURGE  - purge vset
+/-IOFILL   - fill vset
+/-IOZERO   - zero vset
+/-IOZVENT  - zero vent vset
+/-IOZCAL   - zcal vent vset
+/-IOSZERO  - szero vset
+/-IOSZVENT - szero vent vset
+/-IOSAMPLE - sample measurement vset
+/-IOAIR    - air measurement vset
+/-IOSTD    - standard measurement vset
+/-IOSTDFILL - standard fill vset
+/-IOREST   - rest vset
+IOEXCERN   - exercise step n[1:8] vset (+ only)
+/-IOSCAL   - scal vset
+/-IOSCALGAS - scal gas vset
```

## <macro> Values

```
FILL      - Fill volume
PURGE     - Empty volume
ACID      - Inject acid
ZERO      - Zero path
ZCAL      - Zero calibration
SZERO     - SZero calibration
SAMPLE    - Sample measurement
AIR       - Air measurement
SCAL      - Standard calibration
STD       - Standard measurement
MTERM     - Turn of pump and LI-COR
REST      - Put valves in rest state
VEX       - Exercise valves
```

notes :

- [1] Operations are evaluated and executed left to right.
- [2] Command and options are case-insensitive.
- [3] Command length limited by UI\_CMD\_BUF\_BYTES (console context) or SCR\_LINE\_BUFFER\_BYTES (in script context). Use multiple lines for long sequences.
- [4] options pt, ph, pl, pn, mt, mh, ml, mn
  - are sticky (per command line), may set multiple times
  - use a default value if unset
  - defaults used if unset (see cli\_impl.h)
- [5] pump cycles (pn) must be set >0 to enable pump IO presets e.g. "mdio pn10 spump"
  - pn, mn are sticky (per command line)
  - may be set multiple times on same line
  - use phl/plh to actuate multiple pumps simultaneously

examples :

```
IO preset:
# Run purge macro (set up valve IO, w/ pump, delays, etc.)
mdio purge

# Set valve IO preset only
mdio +iopurge

# Clear valve IO preset only
mdio -iopurge

Using mdio with mmeas:

# Use setup macro prepare for sample measurements
mdio sample

# Take measurements
mmeas mmpbl prebl mms sample mmpob postb

# Use mterm macro to turn off air pump and LI-COR
# after measurement
mdio mterm
```

User defined IO sequence:

```

user defined sequence.
# Execute the following sequence
# - pulse v1a, v3a,b ON
# - wait 5s
# - pulse acid pump 15 cycles (300 ms ON, 200 ms OFF)
# - turn on air pump
# - wait 10s
# - turn air pump OFF
# - set pump cycles=10 and run sample pump with default pump pulse timing
# - put IO in rest configuration
mdio sh1:v1a/v3,5000 ph1:pa,300,200,15 +air d10000 -air pn10 spump rest

```

## MMEAS

```

use      : mmeas <cmd>:[options]

brief    : Configure and/or execute one or more LI-COR measurement profiles and direct output

Commands (<cmd> values):

CYC      - Control measurement cycle parameters
           use: CYC:[option,...]
           Options:
             <RTID> - record type ID
             <RMID> - record measurement ID
             RST    - reset measurement buffer (resets rtid, rmid, mmid)
                       does NOT clear cycle or meas queues
             START  - increment cycle ID, truncate cycle log
             END    - set cycle ID to INVALID, reset meas sequence

           Example:
           Reset measurement buffer, start cycle using record type to RTZ0, record measurement ID RMSAMPLE
           cyc:rst,start,rms,rtz0

USR<n>    - Configure user-defined measurement profile (sticky)
           use: USR<n>:[option,...]
           Options:
             <MEAS_PRESET> - copy measurement preset (optional, specify first)
             <MEAS_PARAMETER> - measurement parameters
             <RTID>
             <RMID>
             <MMID> - record MMID (logged value)
             <OPID> - operation MMID
                       If MMSCAL, MMZCAL, enables/disables cal write to
                       LI-COR if cal_wr=='+'

           Example:
           Set user measurement profile, based on AIR preset;
           overrides blanking time and number of samples.
           usr2:AIR,b2000,n13

           Change USR2 LI-COR period to 1.0
           usr2:p1.0

LOAD,TM - Load measurement profile(s), optionally apply overrides and run automatically.
           LOAD will load and configure a profile, but requires explicit RUN to execute.
           This enables load/inspect without running.
           TM automatically runs specified profile(s) immediately after processing options.

           use: LOAD:[option,...] or TM:[option,...]

           Options:
             <MEAS_PRESET> - load measurement preset name
             USR<n>        - load user-defined profile
             <MEAS_PARAMETER> - measurement parameters (overrides)
             RUN           - run current profile

           Example:
           Load and run SAMPLE preset, override number of LI-COR samples
           mmeas meas:sample,n14,run
           mmeas tm:sample,b2000,air

OUTC      - Output cycle record buffer
           use: outc:[CHLQ]*,[PBRCTXHDV]*

OUTM      - Output last measurement
           use: outm:[CHLQ]*,[PBRCTXHDV]*

OUT<n>    - Output record measurement[0<=n<12]
           use: out[0-9]+[0-1]*:[CHLQ]*,[PBRCTXHDV]*

           where

           [CHLQ] - destination flags
           C : console
           H : host
           L : log
           Q : queue

```

[PBRCTX\*HDV] - format flags (optional, for console only)

P : Pretty  
B : Base85 (ASCII encoding, more efficient than uuencode)  
C : CSV  
R : raw  
X : hex  
XX : PrettyHex  
X\* : hex+PrettyHex  
H : header  
D : data  
V : enable verbose content (if any)

Examples:

mmeas outm            output last meas to console (Pretty)  
mmeas outm:c,b        output last meas to console (Base85)  
mmeas outm:c,pxx      output last meas to console (Pretty & PrettyHex)  
mmeas outc:ql         output measurement buffer to (cycle) queue and summary log  
mmeas outm:q          output measurement to (meas) queue  
mmeas out4:q          output 5th (i.e. index=4) measurement to (meas) queue

SHOW - Inspect record buffer summary and measurement profiles  
      use: show:[A\*BCHOPRU]

where

[A\*BCHOPUS] - information flags

A,\* : all  
B : measurement buffer  
C : measurement cycle record  
H : help  
O : current operation profile  
P : preset profiles  
U : user-defined profiles  
S : state info

MMEAS options:

## <RTID> Values

RTZ0 - set record type to default  
RTX<x> - set record type (user defined)  
      use: rtx<x> (e.g. rtx3e5)

## <RMID> Values

RMSAMPLE,RMS - set record measurement type sample  
RMSCAL,RMSC - set record measurement type scal  
RMZCAL,RMSZ - set record measurement type zcal  
RMX<x> - set record measurement type (user defined)

## <MMID> Values

MMAIR,MMA - set measurement ID air  
MMSTD,MMST - set measurement ID standard  
MMZERO,MMZ - set measurement ID zero  
MMSAMPLE, - set measurement ID sample  
MMPRES,MMPRS - set measurement ID pre-standard  
MMPOSTS,MMPOS - set measurement ID post-standard  
MMPREZ,MMPRZ - set measurement ID pre-zero  
MMPOSTZ,MMPOZ - set measurement ID post-zero  
MMPREB,MMPRB - set measurement ID pre-baseline  
MMBLINE,MMB - set measurement ID baseline  
MMPOSTB,MMPOB - set measurement ID post-baseline  
MMZCAL,MMZC - set measurement ID z-calibration  
MMSCAL,MMSC - set measurement ID s-calibration  
MMX<x> - set measurement ID user-defined

## <MEAS\_PARAMETER> Values

P<n> - set LI-COR sample period (decimal sec, 0.0 or >=0.5)  
      use: p<f> (e.g. p0.5)  
  
T<n> - set measurement time  
      use: t<n> {e.g. t30000}  
          if t=0, runs until user interrupt (CTRL-D on CTTY)  
  
N<n> - set measurement sample count  
      use: n<n> {e.g. n16}  
  
B<n> - set blanking period (msec)  
      use: b<n> {e.g. b2000}  
  
W<n> - enable/disable calibration value write to instrument  
      use: w[+-] (e.g. w+)  
  
D<n> - delay for specified time (immediate, msec)  
      use: d<n> {e.g. d12500}  
  
F<c> - set streaming handler function  
      use: F[O|Z]  
          O - orecord stream to console  
          Z - zrecord output to queue  
  
L<c> - set streaming lot output options  
      use: O|R|\*

```

R - log raw records (always set for zrecord handler)
O - log oreords
* - log both raw and oreords

C<c> - set streaming console output options
      use: C[:<fmt>]
          where
          <fmt> is one or more of:
            B - B85
            C - CSV (default)
            M - Mixed (CSV with ASCII hex fields)
            P - Pretty
            R - Raw
            X - Hex
            XX - Pretty Hex
            [use X* for both hex and pretty hex]

      notes:
        [1] Pretty format may affect ability to keep up with serial stream
        [2] If L is specified, console output is suppressed
        [3] out* options apply only to zrecord handler
        [3] Raw mode is for M2M and debugging only

      examples:
        # use oreord handler
        - stream CSV format to console (default)
        tm:air,fo

        # use oreord handler
        - stream CSV format to console, until CTRL_D received
        tm:air,fo,t0

        # use oreord handler
        - stream B85 format to console
        tm:air,fo,C:B

        # use oreord handler
        - log oreords only (to OBIN and CBIN logs)
        - stream B85 and pretty hex format to console
        tm:air,fo,L0,C:BXX

        # use oreord handler
        - log raw and oreords (RAW, OBIN and CBIN logs)
        - stream CSV (mixed) and B85 to console
        tm:air,fo,L*,C:MB

        # log raw and oreords
        - use zrecord stream handler (default)
        - when measurement complete, add to measurement queue
        - display on console (pretty format, header only)
        - write measurement queue to zbin log
        tm:air,L* outm:qcl,ph

## <MEAS_PRESET> Values

<preset> - use pre-defined measurement parameters
          FILL - Fill the chamber
          PURGE - Purge gas
          ACID - Inject acid
          ZERO - Zero gas paths
          ZCAL - Zero calibration
          SCAL - Standard calibration
          SZERO - Zero standard paths
          SAMPLE - Measure sample
          AIR - Measure air
          STD - Measure standard

      notes:
        [1] Operations are evaluated and executed left to right.
        [2] Command and options are case-insensitive.
        [3] Command length limited by UI_CMD_BUF_BYTES (console context)
            or SCR_LINE_BUFFER_BYTES (in script context). Use multiple lines
            for long sequences.

      examples :

        # reset measurement buffer (e.g. at start of cycle)
        # and set record measurement type to RMSAMPLE
        # truncate cycle buffer
        mmeas cyc:rst,start,rms

        # take sample measurement, output measurement to console
        # does not update OBIN log or cycle queue
        # does update RAW log and measurement queue
        mmeas tm:sample outm:c,pdh

        # take air sample (using mmid=99) and output record to cycle queue
        # does not update measurement queue, OBIN log, CBIN log
        # does update cycle queue, RAW LOG
        mmeas tm:air,mm99 outc:q

        # take zero sample, log raw and oreords, stream oreords to console (as CSV)
        # does not update cycle or measurment queues
        # does update RAW and OBIN logs
        mmeas tm:zero fo 1* air

```

```

mmeas cm:zero,10,1,0,0
# write cycle queue to ZBIN, end cycle
mmeas outc:l cyc:end

# load user-defined profile and show measurement info
mmeas load:usr3 stat:OB

# output cycle record to console, in pretty and pretty hex format,
# with data and headers
mmeas outc:c,pxxdh

# output 5th (i.e. index 0:4) measurement to (meas) queue
mmeas out4:q

# output last measurement to console (Pretty)
mmeas outm

# output record to console (Base85)
mmeas outm:c,b

```

## Contents

# Topic APP\_LI

(LI-COR)

Application specific : LI-COR gas analyzer control API

## LI CAL

```

use      : li cal <id> [ D<delay>]
brief    : perform calibration
input    : id      - cal ID, where <id> may be
              z      [zero]
              s:d.ddd [span]
              s2:d.ddd [span2]
input    : delay - extend delay (in addition to 10s max implemented)
return   : none
examples :
  li cal s:452.1 [S cal, span concentration 452.1]
  li cal s2:23.05 [S2 cal, span concentration 23.05]
  li cal s:0      [S cal, use LI_SPANC configuration for span concentration]

```

## LI INIT

```

use      : li init
brief    : initialize LI-COR
return   : none
examples :
  # initialize LI-COR
  li init

```

## LI MODEL

```

use      : li model [Q] [<model>]
brief    : set/get LI-COR model number
          : sets LICOR_MODEL config variable and
          : internal configuration instance
input    : Q          - quiet (don't output model number)
input    : <model>    - model number 850|830
return   : none
examples :
# get LI-COR model
li model
# set LI-COR model 850 (don't report)
li model Q 850

```

## LI RATE

```

use      : li rate <period>
brief    : set LI-COR output rate [1]
input    : period    - output period (s) [range 0.0 or >=0.5]
return   : none

notes    :
[1] The use of OR instead of RATE is also supported

examples :
# set LI-COR output rate to 0.5s
li rate 0.5

```

## LI STAT

```

use      : li stat [i<indent> v] <tag>...]
brief    : output LI-COR status to console (formatted xml)
input    : indent    - number of space to indent
input    : v          - verbose output
input    : tag        - output contents of first occurrence of tag
return   : none
examples :
# show <rs232>...</rs232> and <cfg>...</cfg>
li stat rs232 cfg
# show all, indent 8 spaces
li stat i8

```

### Contents

# Topic LOG

(logging)

Access log entries and metadata.

## LOG

```

use      : log [S|C] <msg>
brief    : add annotation to syslog (default) or cycle log
input    : msg - message to log
return   : none
notes    :
[1] quoted messages may use variable substitution

examples :
# add annotation to syslog
log 'nice weather we're having'

# add annotation to cycle log (include value of CX0 reg)
log c "cycle starting $CX0"

```

## LSEG

```

use      : lseg <hnd> [<val>]
brief    : get/set log segment size [1]
input    : hnd - log handle 0:syslog 1:data 2:raw
input    : val - log segment size, n>0
           may also use K,M,G suffix (e.g. 10M) for KByte, MByte, GByte
return   : none
notes    :
[1] Chances are you don't need to change this. Use caution if you do, as setting the
    segment size too large can degrade real-time performance (file seek times increase,
    interfering with sample buffering and timing).

```

## LSHOW

```

use      : lshow [<hnd>]
brief    : show summary of log data structures
input    : hnd - log handle 0:syslog 1:data 2:raw
return   : none
examples :
# show the status of the raw log
lshow 2

```

## LCAT

```

use      : lcat <type> [<options>] [src:]<file>
brief    : show selected log records using specified formatting
input    : <type> - log type
              0:orecord
              Z:record
input    : s<n> - start record index (zero-based)
input    : c<n> - number of records
input    : l<n> - last <n> records
input    : h - show use message
input    : filters - use <type><op><a>[,<b>]
              where:
                <type> : search type (te, ti, etc.)
                <op> : operator [=, !=, >, <, >=, <=, <>, ><]
                <x,y> : value or range (x: low, y:high)
                types:
                  ti : ISO8601 time
                  te : epoch millisec
                  rt : record type
                  rm : record id
                  mm : measurement id
                  esn : ensemble sequence number
                  msn : measurement sequence number
                  sn : sequence number
                  cn : cycle ID
                  idx : index number

input    : output - use out:<fmt>
              <fmt> - output formatting
                P : pretty
                XX : pretty hex
                X : hex
                X* : pretty hex + hex
                B : base85
                C : CSV
                M : CSV (mixed i.e. hex fields)
                R : raw
                H : header
                D : data
                V : verbose (show record index/offset)
input    : dbg:<x> - debug mask (hex)
              also accepts operators
                + : current setting |= <x>
                - : current setting &= ~<x>
                = : current setting = <x>
input    : gmt:<n> - gmt offset (h) (use before time filters)
input    : file - log file name (e.g. dat2003.000)
              use src: specifier if not last argument

defaults : out:PDHV s=0 c=1 (all records) gmt:-8
return   : none
examples :
  # show last three records of dat2010.000 pretty format, include data and headers
  lcat z 13 src:dat2010.000 out:pdh

  # show records with timestamps between 1604189028000 and 1604189030000
  lcat z te><1604189028000,1604189030000 src:dat2010.000 out:ph

  # show last three records of the CBIN buffer in Base85 format
  lcat o 13 out:b $CBUF

```

LLESS

```

use      : lless <type> [<options>] [src:]<file>
brief    : interactive log inspection
input    : <type>      - log type
                        O:orecord
                        Z:record
input    : out         - use out:<fmt>
                        output format control (may be changed interactively)
input    : dbg:<x>      - debug mask (hex)
                        also accepts operators
                        + : current setting |= <x>
                        - : current setting &= ~<x>
                        = : current setting = <x>
input    : gmt:<n>      - gmt offset (h) (use before time filters)
input    : file        - log file name (e.g. dat2003.000)
                        use src: specifier if not last argument
return   : none
summary  : There are three types of inputs:
          Movement : navigating records
          Command   : search, output settings
          Session   : control session, help, etc.

Movement :
First/Last [ g <      ] / [ G >  ]
Next/Prev  [ dD<CR> ] / [ uU   ]
This       [ <SPC>   ]
Jump +/-   [ j<n>    ] / [ k<n>   ]

Session   :
Help [h H ?]   Quit [q Q x X]

Command   :
Enter cmd mode [ / ]
Search -
    gmt : <offset h>
    te  : epoch_msec ti:iso1806
    rt  : rtid rm:rmid
    mm  : mmid
    esn : ensemble_n
    msn : measurement sequence number
    sn  : sequence number
    cn  : cycle ID
    idx : record index

    use : <type><op><x>[,<y>]
    where :
        <type> : search type (te, ti, etc.)
        <op>   : operator [=, !=, >, <, >=, <=, <>, ><]
        <x,y>  : value or range (x: low, y:high)

    Next match [n]
    Prev match [N]

Output -
    out:<fmt> where fmt is one or more of
        P : pretty
        XX : pretty hex
        X  : hex
        X* : pretty hex + hex
        B  : base85
        C  : CSV
        M  : Mixed CSV/hex
        R  : raw
        H  : header
        D  : data
        V  : verbose (show record index/offset)
    dbg:<32-bit hex mask>

```

# LINSPECT|LINFO

```

use      : linfo O|Z [h] [out:prcieh] <file...>
brief    : show log record summary
input    : file - log file name (e.g. dat2003.000)
return   : summary

notes    :
[1] interrupt with CR or CTRL-D

summary : options:
        h - help
        out - specify output options
            p - pretty format (default)
            r - record counter (progress)
            c - CSV format (useful for machine-machine queries)
            e - epoch time (posix, CSV only)
            i - ISO8601 time (CSV only)
            h - include CSV header (CSV only)

examples :
# show data log summary (pretty and CSV, ISO8601 time format, include header)
linfo z dat2010.000 out:pcih

```

## LSEQ

```

use      : lseq O|Z|C
brief    : show next sequence number (from file)
input    : Z - zrecord log
input    : O - orecord log
input    : C - cycle log
return   : next available sequence number (i.e. number of records in segment)
examples :
# show next sequence number
lseq

```

## LSETSEQ

```

use      : lsetseq O|Z|C [<n>]
brief    : set next sequence number (in sequence number file)
input    : Z - zrecord log
input    : O - orecord log
input    : C - cycle log
input    : n - new value (uint32) - resets to zero if unspecified
return   : new sequence number
notes    :
[1] Intended to recover from accidental deletion of sequence number file, disk swap, etc.
[2] Use with caution: changing the sequence number may have side effects (e.g. post processing).

examples :
# set next OBIN log sequence number to 5
lsetseq O 5
# reset next ZBIN log sequence number to 0
lsetseq Z

```

### Contents

# Topic QUEUE

## (sample queue management)

The system exposes two queues, a record queue and a measurement queue. These may be used to aggregate related measurements and records, for example the most recent measurements or record. The queue API allows users and client software to inspect and/or delete queue contents.

This can be useful for an operation model in which a client periodically requests the latest measurements or records. The queue API may also be used to transfer measurements or records to the data log.

The MMEAS API uses an internal cycle measurement queue to store measurements. The cycle is not directly accessible to users. MMEAS output commands may be used to transfer cycle queue contents to the measurement and record queues or data log.

---

## QCOUNT

```
use      : qcount i<id>|m|c
brief    : return number of queue entries
input    : id      - queue ID 0:meas 1:cycle (or use M:meas C:cycle)
return   : number of queue entries
examples :
  # show number of entries in measurement queue
  qcount i0
```

## QCLEAR

```
use      : qclear i<id>|m|c
brief    : delete all queue entries
input    : id      - queue ID 0:meas 1:cycle (or use M:meas C:cycle)
return   : none
examples :
  # empty the cycle queue
  qclear i1
```

## QPEEK

```
use      : qpeek i<id>|m|c [<first>] [<n>] [OUT:<dest>[,<fmt>]]
brief    : examine queue entries (don't delete)
input    : id      - queue ID 0:meas 1:cycle
input    : first   - starting queue entry
input    : n       - number of entries or '*'
input    : dest    - output destination
                  C:console
                  H:host
                  L:log
input    : fmt     - output formatting/content
                  P : pretty
                  XX : pretty hex
                  X  : hex
                  X* : pretty hex + hex
                  B  : base85
                  C  : CSV
                  M  : mixed CSV/hex
                  R  : raw
                  H  : header
                  D  : data
                  V  : verbose
return   : decoded queue entries
examples :
  # inspect the first 2 entries in the measurement queue
  qpeek i0 0 2

  # inspect the first entry in the measurement queue, format as Base85
  qpeek m out:c,b
```

## QPOP

```

use      : qpop i<id>|m|c [Q] [OUT:<dest>[,<fmt>] <n>
brief    : delete and optionally show next (oldest) n entries from queue
input    : id      - queue ID 0:meas 1:cycle (or use M:meas C:cycle)
input    : n        - number of entries or '*' for all
input    : Q        - suppress output (just delete)
input    : dest     - see QPEEK
input    : fmt      - see QPEEK
return   : oldest n entries in the queue (or none if Q specified)
examples :
# remove the first 3 entries from the measurement queue,
# send contents to console in Base85 format
qpeek i0 2 out:c,bdh

```

## QSHOW

```

use      : qshow i<id>|m|c
brief    : print queue summary
input    : id      - queue ID 0:meas 1:cycle (or use M:meas C:cycle)
return   : queue summary
examples :
# show cycle queue summary
qshow 1

```

### Contents

# Topic SCR

## (scripting)

Commands used for managing scripts

## SCR SDEBUG

```

use      : scr sdebug +|- <id>
brief    : enable/disable debug output for specified script
input    : id - script name or handle
return   : none
examples :
# enable script debugging for script ID 1
scr sdebug + 1

```

## SCR DELAY

```

use      : scr delay <time_ms> <id>
brief    : delay specified period before executing next command (suspend execution)
           Run timer continues to run and resumes when delay expires.
           If period ==0 resume
           if period <0 pause indefinitely
input    : time_ms - delay time (ms)
input    : id      - script name or handle
return   : none
examples :
# pause scr 0 for 30 sec
scr delay 30000 0

```

## SCR END

```
use      : end
brief    : end of script [only valid in script context]
return   : none
```

## SCR JOG

```
use      : scr jog <id>
brief    : enter manual mode and begin single-step execution
          : subsequent calls advance the specified script one line
input    : id - script name or handle
return   : none
examples :
# put scr 2 in manual mode, advance one step
scr jog 2
# advance one step
scr jog 2
# resume (continue running from current line)
scr run 2
```

## SCR LOAD

```
use      : scr load [<+/->] <file> [<file>...<+/->]...
brief    : load specified script(s) into next available handle
input    : file - script file name
input    : o      - enable/disable overwrite for files that follow (may use more than once)
          :          overwrite is enabled by default.
return   : confirmation or error message
examples :
# load "3step.scr" (fail if already loaded)
scr load 3step.scr
# load a.scr and b.scr, overwrite b.SCR
scr load a.scr o+ b.scr
```

## SCR RUN

```
use      : scr run [out:h|c] <id>
brief    : run the specified script [1]
input    : id - script name or handle
input    : H,C - send output to H:host or C:console (default)
return   : none

notes    :
[1] Script lines run to completion without interruption.
    Console and Host IO are processed between script lines, allowing a script to be
    killed, e.g. Response to user IO may be slow.
[2] Scripts may be run concurrently, executed one line per cycle, in order
    starting with script ID 0.

examples :
# load and run script a.scr
scr load a.scr
scr run a.scr
```

## SCR KILL

```
use      : scr kill <id>...
brief    : stop running the specified script
          : Stops execution and cancels schedule.
          : Does not change hardware states.
input    : id - script name or handle
return   : none
examples :
# stop script a.scr
scr kill a.scr
# stop script ID 0
scr kill 0
```

# SCR RESET

```
use      : scr reset <id>
brief    : reset (cancels) the delay timer for specified script
          : Does not change the run timer, i.e. run timer continues running
          : during delay, and the resumes when delay timer is reset.
          : Use sync to reschedule or kill to stop.
input    : id - script name or handle
return   : none
examples :
# reset script a.scr delay timer
scr reset a.scr
```

# SCR SCH

```
use      : scr sch P<period_ms> D[<sync_delay>] [out:C|H] <id> ...
brief    : schedule script, optionally synchronize (run)
input    : period_ms - schedule period (ms)
input    : sync_delay - delay before sync
                  0 (or just D): now,
                  >0           : start after delay
                  <0 (default) : don't sync]
input    : out:C|H    - set output tty
                  C : console
                  H : host

input    : id          - script name or handle
return   : none
examples :
# run a.scr every 20 min, start now
scr sch P1200000 D a.scr

# set b.scr schedule every 5 min and a.scr every 20 min, but don't start
scr sch P300000 b.scr P1200000 a.scr

# set a.scr schedule every 5 min, starting in 3 min
scr sch P300000 D180000 a.scr

# set a.scr, b.scr schedule every 5 min, start a.scr in 3 min, b.scr now
scr sch P300000 D180000 a.scr D0 b.scr
```

# SCR SHOW

```
use      : scr show [<id>...]
brief    : print script parameter summary for one or more scripts
input    : id - script name or handle or '*'
return   : none
examples :
# show script status/summary for all scripts
scr show
# show script status/summary for script ID 0
scr show 0
# show script status/summary for script a.scr
scr show a.scr
```

# SCR STAT

```
use      : scr stat <id> ...
brief    : get script state
input    : id - script name or handle
return   : none
examples :
# shift (existing) a.scr schedule 15 min
scr sync D900000 a.scr
# shift a.scr schedule to now (or run immediately if not scheduled)
scr sync a.scr
```

# SCR SYNC

```

use      : scr sync [D<time_ms>] <id> ...
brief    : start script after optional delay
           Shifts scheduled start time.
input    : time_ms - delay time (ms) (default is 0)
input    : id      - script name or handle
return   : none
examples :
# shift (existing) a.scr schedule 15 min
scr sync D900000 a.scr
# shift a.scr schedule to now (or run immediately if not scheduled)
scr sync a.scr

```

## SCR UNLOAD

```

use      : scr unload <id>
brief    : unload specified script.
input    : id - script name or handle
return   : none
examples :
# unload a.scr
scr unload a.scr
# unload script ID 0
scr unload 0

```

## CRON

script scheduler with cron schedule syntax

version >= 3.1.0b0

```

use      : cron [options]
brief    : manage cron schedules
options  :
+|-<tmout_ms>          enable/disable cron
                        use optional disable timeout to automatically resume
                        (e.g. in the event of disconnection) [6]

X                      show time to next scheduled event (decimal sec)
                        - disabled tabs excluded
                        - indicator (+|-) shows cron enable status

L:USR|SYS|*             list tab file contents
S:USR|SYS|*             show tab status
C:USR|SYS,<flags>        configure tab flags
                        +|-e: enable/disable tab
                        +|-x: enable/disable exclusive mode
                        +|-s<i>: suspend/resume task[i] state updates

F:USR|SYS,<file>        set tab file
T:USR|SYS,<i>,"<sch>"[,<scr>] configure task schedule and script (optional)

R:USR|SYS,<i>           reset task[i]

return   : varies, status info etc.

notes    :

[1] changing schedules or tab files unloads scripts immediately, with no changes to IO.
[2] enabling exclusive mode takes effect in the next execution cycle
[3] disabling cron or crontab does not change files or schedules. In concurrent mode,
    currently running scripts will run to completion.
[4] schedule syntax: schedules are space-delimited strings with 6 fields:

    mon mday h m s wday

    mon : month      values: 1-12 JAN(1) FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
    mday: month day  values: 1-31
    h:   hour        values: 0-23
    m:   minute       values: 0-59
    s:   second       values: 0-59
    wday: weekday     values: 0-6 SU(0) MO TU WE TH FR SA

    Fields are comma-delimited specifiers which may include

    individual fields val
    ranges               val-val
    wildcard             *
    modulus              */n
    range w/ modulus     val-val/n

example:
# mon: every third month

```

```
# MON: every other MON,
# mday: every other day
# hour: every other hour between 0000-0600 and every hour 1800-2000
# every 20 min and half past the hour
# wday: MO,TH,FR,SA
JAN-DEC/3 */2 0-6/2,18-20 */20,30 MO,TH-SA
```

[5] crontab syntax: crontabs (tables) are text files containing task specifiers consisting of a schedule and a task (script) name:

```
"schedule" = task

schedule : schedule specifier (see description, above)
task      : script name

- comments are allowed
- everything following "#" or "/" is a comments
- comments may appear at the end of a line
- leading/trailing whitespace is allowed (and surrounding '=')
- schedule specifier must be in single or double quotes

crontabs may contain a configuration line, which may be used to set flag values:

flags=<flags>

where flag values are as described above. The exclusive mode flag indicates that
scripts should be run from start to finish without yielding. If unset, scripts
are executed as other scripts would be, yielding between states. Currently, the
exclusive flag applies to all tasks defined in the crontab.

Scripts are unloaded on completion or error.

There are two crontabs in the system: CRONTAB.SYS and CRONTAB.USR.
Each crontab may hold up to 4 schedule specifiers.
However, there are a total of 4 script slots for the system.
```

example:

```
# user cron tab
flags = +x+e
"* * */2 */10 0 MO-FR" = utime.scr
```

[6] Note that if a timeout is specified, cron will be enabled when the timeout expires, regardless of its state before suspension. This may be used to start/resume cron after a delay. To suspend cron indefinitely, use '-' with no timeout.

```
examples :
# show USR crontab contents
cron l:usr
# show cron status and time to next event
cron s:* x
# set usr crontab to exclusive mode and enable
cron c:usr,+x,+e
# set usr crontab task ID 0 schedule (every other day, every 20 min between 0600-18:00)
# Note: quotes required for t: option
cron t:usr,0,"* */2 6-18 */20 0 SU-SA/2"
# set sys crontab file to testtab.sys
cron f:sys,testtab.sys
# suspend cron indefinitely
cron -
# suspend cron for 5 min
cron -30000
# resume cron (cancels suspend timer if set)
cron +
```

## Contents

# Topic GET

(inspection)

Utilities for inspecting system status and state

## GET AD

```

use      : get ad <port>[:DXn]...
brief    : show A/D converter voltage
input    : port - ADC port [0:2]
output   : DXn - store result in DXn [0 < n < SCR_DX_COUNT-1] (optional)
return   : ADC - voltage [0-5V]
examples :
# read ADC0 into DX0 and ADC2 into DX1
get ad 0:dx0 2:dx1

```

## GET BITS

```

use      : get bits [CXn]
brief    : show IO bit state summary
output   : CXn - store result in CXn [0 < n < SCR_CX_COUNT-1] (optional) [1]
return   : IO bit states

notes    :
[1] - ADC2 does not have an enable bit, always off

examples :
# show bit states
get bits
# show bit states, read into CX0
get bits CX0
# show stored bits in cx0 (decimal)
creg CX0
# show stored bits in cx0 (hex)
print "%LX\r\n" CX0

```

## GET ERR

```

use      : get err [Q] [CXn...]
brief    : show return code of last command
           optionally store in CX register
input    : Q - suppress console output
output   : CXn - store result in CXn [0 < n < SCR_CX_COUNT-1] (optional) [1]
return   : return code of last command

examples :
# get status (valid command)
>>ver

MBARI CO2/DIC
firmware[ cwg_nonboot v0.0.0 tag 3.3.0b0]
build   [ Nov 12 2020 - 16:33:57 ]
status  [ 2083 ]
cfg_sn  [ 0005 ]
sys_sn  [ FFFF ]

>>get err
0

# get status, store in CX0 (invalid command)
>>foo
NO COMMAND

>>get err Q CX0

>>creg cx0
CX0 = 4

```

## GET NEXT

```

use      : get next
brief    : show time (s) until next scheduled activity
return   : time (s) or SYS_MAX_SLEEP_MS if no events pending
examples :
# get next computed time
get next

```

## GET PRINT

```

use      : get print [DV]
brief    : show value of debug and verbose print variables
          used to configure DPRINT and V*PRINT macros
return   : value of debug and/or verbose print variables
examples :
# show debug and verbose setting
get print

```

## GET SER

```

use      : get ser [N<m>] <port>
brief    : read from serial port string until
          - m bytes received (m>0)
          - no bytes available (m==0)
          - indefinitely (m<0)

          May interrupt using CTRL-D any time.
          Sends received bytes to console.

input    : port - serial port [0:2|C|H|L]
          0,H : host
          1,L : LI-COR
          2,C : console
return   : bytes read
examples :
# get 50 bytes input from the LI-COR port
get ser L N50

```

## GET TIME

```

use      : get time [u]
brief    : show system time
input    : u - output epoch time (optional)
return   : current date/time
examples :
# get time/date and epoch seconds
get time u

```

## GET VAR

```

use      : get var [V] [key...]
brief    : display one or more variable values
input    : V - verbose output
input    : key - variable name (key)
return   : value of <key>, or list of key/value pair
          values if if unspecified
examples :
# show all configuration variables
get var
# show configuration variable ECHO
get var echo

```

### [Contents](#)

# Topic SET CLR

(change system hardware state)

Utilities for changing system hardware state parameters.  
 The set API provides full, fine-grained control of system IO.  
 The mdio API is application-specific, used for pCO<sub>2</sub>/DIC sampling.

# SET BAUD

```
use      : set baud <port> <bps>
brief    : set UART communication speed (bps)
input    : port - serial port [0:2|H|C|L]
input    : bps - rate (bps) [300,600,1200,2400,4800,9600,19200,38400]
return   : none
examples :
# set host port communications rate to 19200
set baud H 19200
```

# SET BITS

```
use      : set bits [<id>...]
brief    : set (HI) one or more digital IO bits
          see also clr bits, pulse bits, and MDIO

input    : id - bit number or name
          #<n> : bit n (decimal)
              0:19 valves/acid pump/sample pump
              20:21 pump
              22:22 LI-COR
              23:24 analog
              26:28 RS232 drivers
          x<n> : bit mask n [0-FFFFFF] (hex)
          a<n> : ADC n 0:1
          a*   : all ADC
          vn   : valve n A&B
          vnA|B : valve n A,B
          v*   : all valves
          p<n> : DC pump n 0:5
          pi,pr : air pump
          pe,pw : seawater pump
          pa   : acid pump
          ps   : sample pump
          pd   : DC pumps (air, seawater)
          px   : solenoid pumps (acid, sample)
          p*   : all pumps
          l    : LI-COR DC power
          uh   : host UART xcvr
          ul   : LI-COR UART xcvr
          uc   : console UART xcvr
          cx<n> : use mask in specified CX register

return   : none
examples :
# set air pump, valves SV3A and SV7A+B and the licor power and transceiver enable bits
set bits pr v3a v7 ul l
```

# CLR BITS

```
use      : clr bits [<id>...]
brief    : clear (LO) one or more digital IO bits
input    : id - bit number or name (see SET BITS)
return   : none
examples :
# clear all pump, valve and ADC enable bits
set bits p* v* a*
```

# SET PRINT

```
use      : set print [D<n>] [V<n>]
brief    : set value of debug and verbose print variables
          used to configure DPRINT and V*PRINT macros
          DPRINT is enabled if !=0
          VPRINT is enabled if !=0, and supports multiple levels (>0)
return   : none
examples :
# enable debug printing and verbose level 2
set print d1 v2
```

# SET SER

```
use      : set ser <port> <string>
brief    : send serial string to specified serial port
input    : port - serial port [0:2]H|C|L]
input    : string - string to send
return   : none
examples :
# send "hello\r\n" to the host port
set ser H "hello\r\n"
```

# SET TIME

```
use      : set time <YY[YY]> <MM> <DD> <hh> <mm> <ss>
brief    : set system time/date
input    : YY[YY] - year [00-9999]
input    : MM      - month [01:12]
input    : DD      - day [01:31]
input    : hh      - hour [00:23]
input    : mm      - minute [00:59]
input    : ss      - second [00:59]
return   : new time
examples :
# set time to 2010/10/03T11:13:42
set time 2020 10 3 11 13 42
```

# SET VAR

```
use      : set var <key> <val>
brief    : set variable <key> to <val>
input    : key - variable name
input    : val - new value (must be appropriate type and format)
return   : none
notes    :
```

Configuration variables are strongly typed, meaning that they are stored using a specific data primitive. When using SET VAR to change the value of a configuration variable, the value must be formatted appropriately for it's native data type.

SET VAR parses values using C printf formats; it will typically try several formats; hex values should be prepended with 'X' disambiguate them from decimal values.

| Type   | Internal Representation      | Default Format | Example                     |
|--------|------------------------------|----------------|-----------------------------|
| bool   | boolean                      | X%02X          | set var FooBool X07         |
| uint16 | unsigned 16-bit integer      | X%04X          | set var FooU16 X0A27        |
| int16  | signed 16-bit integer        | %d             | set var FooI16 42           |
| uint32 | unsigned 32-bit integer      | X%08lX         | set var FooU32 X1234C02     |
| int32  | signed 32-bit integer        | %ld            | set var FooI32 -8675309     |
| uint64 | unsigned 64-bit integer      | X%016llX       | set var FooU64 X123DEADBEEF |
| int64  | signed 64-bit integer        | %lld           | set var FooI64 10000000000  |
| double | 32-bit double                | %ld            | set var FooI32 -3.14159     |
| byte   | unsigned char                | %c             | set var FooByte Z           |
| string | NULL terminated ASCII string | %s             | set var FooByte Z           |

```
examples :
# set var FOO_DBL (double)
set var FOO_DBL 3.14
```

[Contents](#)

# Topic PULSE

## (GPIO momentary switching)

Momentarily assert one or more digital IO bits (in either direction)

---

# PULSE BITS

```
use      : pulse bits <dir> <delay_ms> bits [<id>...]
brief    : pulse one or more digital IO bits (single cycle, e.g. to actuate valves)
input    : dir      - direction [L|0|H|1]
input    : delay_ms - pulse duration (ms)
input    : id       - bit number or name (see SET BITS)
return   : none
examples :
# pulse valves v1a and v4a,b H for 200 ms then return to L
pulse bits H 200 v1a v4
```

# PULSE NBITS

```
use      : pulse nbits <dir> <ta> <tb> <n> bits [<id>...]
brief    : pulse one or more digital IO bits w/ specified duty cycle, number of cycles
          (e.g. to actuate pumps)
input    : dir      - direction [L|0|H|1]
input    : ta       - pulse duration (dir, ms)
input    : tb       - pulse duration (!dir, ms)
input    : cycles   - pulse duration (ms)
input    : id       - bit number or name (see SET BITS)
return   : none
examples :
# pulse acid pump 10 cycles 200ms H/ 300ms L
pulse bits H 200 300 10 pa
```

## Contents

# Topic TEST

(logical IO bit test)

---

Logically test one or more IO bits, and store the result in a register. This may be used to implement flow control in a script context.

---

# TEST BITS

```

use      : test bits [Q] [ MCXn BCXn OCXn ] [M<mask>...] [<id>...]
brief    : test one or more IO bits
input    : Q      - quiet mode (no console output, for scripting)
input    : BCXn   - store bits in CXn
input    : MCXn   - store mask in CXn
input    : OCXn   - store output (mask&bits) in CXn
input    : Mmask  - add <mask> (hex) to bitmask [1]
input    : id     - bit number or name (see SET BITS) [1]
return   : none

```

```

notes :
[1] may be included more than once (all values OR'd)

```

```

examples :
# Using test bits for script flow control
# clear all IO bits (except for tranceivers)
clr bits p* v* a* 1
# set ADC bit
set bits a*
# store current IO state in CX
# store ADC bit state in CX1
test bits a* MCX0 OCX1
# compare bit state vs mask
if [ CX0 == CX1 ] goto pass
# test failed
println "set bits a [ERR / $CX0 / $CX1]"
goto cont
:pass
# test passed
println "set bits a* [OK]"
:cont

```

## Contents

# Topic REG

## (registers)

The system implements a set of multi-purpose variables (registers) that may be used in scripting and expressions. Register variables include

```

CREG : 8 x 32-bit unsigned integer counters
DREG : 8 x 32-bit double
FREG : 32 x flags (boolean, single bit)

```

Some commands allow values to be stored in register variables, and register variables may be used in script boolean expressions.

Register variables are global in scope; they are visible to all scripts and users.

This makes it possible for scripts to communicate using variables.

Users must protect variables from accidental modification through concurrent use.

## CREG

```

use      : creg [fmt] [<reg>] [<reg><op><val>]...
brief    : show, manipulate counter reg (CX0:SCR_CX_COUNT)
input    : reg - register [CXn|*]
input    : op  - operator [=,--,++,+=,-=,*=,/=,%=,|=,&=,&~,~]
input    : val - value [unsigned 32-bit integer] or CXn
input    : fmt - formatting info
              OX, OXn : hex format, width n
              OD, ODn : decimal format, width n
              Wn : width
              - may be specified more than once
              - applies to subsequent output

return   : requested value(s)

notes    :
[1] operators "+", "--" and "~" don't require (or support) values
[2] CREG values are unsigned 32-bit integers

examples :
# operations
creg cx2=0 cx2 cx2+=5 cx2 cx2*=3 cx2%=6 od8 *
# demonstrate rollover
creg cx2=0 cx2 cx2-- cx2 cx2++ cx2
# other regs
creg cx0=3 cx1=4 cx2=cx0 cx2*=cx1 cx0 cx1 cx2

```

## DREG

```

use      : dreg [<reg>] [<reg><op><val>]...
brief    : show, manipulate double reg (DX0:SCR_DX_COUNT)
input    : reg - register [DXn|*]
input    : op  - operator [=,--,++,+=,-=,*=,/=]
input    : val - value [double] or DXn
input    : fmt - formatting info
              OF, OFw/p : decimal format (%lf), width w, precision p
              OE, OEw/p : exponent format (%e), width w, precision p
              OG, OGw/p : auto exponent format (%g), width w, precision p
              Wn : width
              Pn : precision
              - may be specified more than once
              - applies to subsequent output

return   : requested value(s)

notes    :
[1] operators "+", "--" don't require (or support) values
[2] DREG values are 32-bit doubles

examples :
# operations
dreg dx2=0 dx2++ dx2 dx2+=2.5 dx2 dx2/=3.1415 *
# other regs
dreg dx0=3.2 dx1=4.56 dx2=dx0 dx2*=dx1 dx0 dx1 dx2

```

## FREG

```

use      : freg [<reg>] [<op> [<val>]]
brief    : show, manipulate flag(s) (0:31)
input    : reg - register [FXn|*]
input    : op  - operator [=,!]
input    : val - value [1|0]
return   : requested value(s)

notes    :
[1] operator "!" doesn't require (or support) values
[2] FREG values are boolean

examples :
# operations
freg fx2 fx2=1 fx2 fx2=0 fx2 fx2! fx2

```

[Contents](#)

# Topic FSYS

## (file system)

File system commands provide simple capabilities for manipulating files and viewing contents.

## CAT

```
use      : cat [h v<n>] [r:<rspec>] [b|rb:[<start>,<count>]] <file>
brief    : show text file regions, specified by time, lines, offset
input    : h          - help message
input    : v[<n>]      - verbose output
input    : <file>      - file name
input    : l<n>        - last n lines
input    : s<n>c<m>    - m lines, start at line n
input    : <rspec>     - range specifier
                        comma-separated list of range modes and values:
                        <start_mode>,<val>,<end_mode>,<val> [2,3]
                        <mode> : range type [blims][+-]
                                b - byte mode
                                l - line mode
                                i - time mode (ISO8601) [4]
                                m - time mode (epoch msec) [4]
                                s - time mode (epoch sec) [4]
                                - - relative to end of file [5]
                        <val> : range value
                                line/byte count (index >=0)
                                timestamp (epoch sec/msec or ISO8601)
input    : b          - binary (human readable)
input    : rb         - binary (raw, machine/machine)
                        <start> : start offset (zero-indexed)
                        <count> : bytes to output

notes    :
[1] there are two cat implementations, this feature is selected by enabling WITH_UI_XCAT
[2] range specifiers optional; use empty field (no space) if unspecified (,,)
[3] valid end modes include [blims]; others ignored. Start/end time formats must match.
[4] file lines must start with specified timestamp (leading space OK)
[5] line/byte start modes only
    - Defaults: line mode, start at beginning of file, show all
    - Use CR or CTRL-D to interrupt
[6] range values are zero-indexed

examples :
# show last 10 lines of sys2000.000
cat r:-,10 sys2000.000
# show first 10 lines of sys2000.000
cat r:,,,10 sys2000.000
# show first 10 lines of sys2000.000 >= 2020-03-28T00:00:00
cat r:i,2020-03-28T00:00:00,1,10 sys2000.000
# show first 10 lines of foo.csv >= 1592974762 (Tue Jun 23 21:59:22 PDT 2020)
cat r:s,1592974762,1,10 foo.csv
# show 100 bytes starting at line 10 sys2000.000
cat r:l,10,b,100 sys2000.000
# show contents of binary file foo.bin
cat b: foo.bin
# show 30 bytes of foo.bin starting at byte 20
cat b:20,30 foo.bin
```

## CFGEX

```
use      : cfgex <file>
brief    : export current configuration to file [1]
input    : file - destination file
return   : none

notes    :
[1] file will be overwritten if it exists

examples:
# save configuration to foo.cfg
cxgex foo.cfg
```

## CP|MV

```

use      : cp <src> <dest>
brief    : copy contents from src to dest [1]
input    : src - file to copy FROM
input    : dest - file to copy TO
return   : none

notes    :
[1] file will be overwritten if it exists

examples :
# copy foo.cfg to bar.bak
cp foo.cfg bar.bak

```

## DSTAT

```

use      : DSTAT [<dir>...]
brief    : show file system information
input    : vol - volume
return   : file system summary
examples :
# Show summary for SD card top directory
dstat

```

## FSIZE

```

use      : FSIZE [DEL:<del>] [<file>...]
brief    : show file length
input    : file - file name
input    : DEL: - delimiter sequence (e.g. to generate comma-separated output)
return   : file length (bytes) or -1 on error

notes    :
[1] if multiple files are specified, the output is
    made in order specified, delimited by CRLF ("\r\n")
[2] DEL may be specified more than once (affects subsequent output).
    DEL may contain C printf escape sequences
    If the sequence contains whitespace or variable/register references
    (e.g. $CX0)DEL option must be quoted (including DEL:)

examples :
# Show file sizes (each on it's own line)
fsize a.scr b.scr
# Show file sizes (comma delimited)
fsize del:, a.scr b.scr
# Show file sizes (delimiter string)
fsize "del:\t" a.scr b.scr

```

## LC

```

use      : lc <file>
brief    : count lines in text file
input    : file - file to evaluate
return   : number of lines, execution time

notes    :
[1] any console input stops processing
[2] large files may take a long time ( ~1s/1k lines)

examples :
# count lines in sys2010.000
lc sys2010.000

```

## LESS

```

use      : less <file> [<lines>]
brief    : page a text file to the console (with search)
input    : file - file to evaluate
input    : lines - number of text lines per page
return   : none

notes    :
[1] pager does not support terminal control or page buffering;
    output begins at the bottom of the screen.

summary  :

Move     :      Up [u U]      Down [d D CR]
Jump     : First [g <]      Last [G >]
Search  : Find [f /]      Next [n N]
Session : Help [h H ?]    Quit [q Q x X]

```

## LS|DIR

```

use      : ls [<dir> [QF]...] [*<str>]
brief    : list file info
input    : dir - directory [default: root, i.e. 0:/]
input    : Q|F - Q:quiet (file names only) F: full
input    : *<s> - display entries with names containing string <s>
              This is not an generic expression processor, but simply includes
              entries containing the specified string.
return   : list of files in directory
examples:
# show all entries in top directory
ls
# show files with "scr" in their name (e.g. scripts, file names only)
ls Q *scr
# show logs
ls $CBIN $OBIN $ZBIN

```

## REN

```

use      : ren <from> <to>
brief    : change file name (preserves existing file)
input    : from - current file name
input    : to - new file name
return   : none
examples :
# rename junk.txt foo.txt
ren junk.txt foo.txt

```

## RM

```

use      : rm <file> [<file>...]
brief    : delete one or more files
          - does not prompt for confirmation
          - cannot be undone
input    : file - file to delete
return   : none
examples :
# delete foo.txt
rm foo.txt

```

## UPLOAD

```

use      : upload [no-eol] [Q] [B:[<length>]] [T<to_sec>] <file>
brief    : upload ASCII file to root directory
input    : to_sec - timeout (sec) default 15
input    : no-eol - disable auto EOL translation [2]
input    : Q      - quiet output (for machine-machine)
input    : B      - binary mode (for machine-machine)
              <length> : optionally specify number of bytes
return   :
notes    :
[1] in binary mode, no conversions are made. Exits when timeout expires
    or length bytes received. Transmits "BIN_EOT\r\n" or "BIN_TO\r\n" in binary mode
    even if quiet option used.
[2] file will be overwritten if it exists
    otherwise, it will be created
    upload times out after 4s, or may be terminated using CTRL-D

[3] automatically converts line ends by default:
    replace \r\r, \n\n with \r\n\r\n
    replace .\r., .\n. with .\r\n.
    add \r\n to end of file if it doesn't exist

[4] some terminal emulators may not support direct ASCII upload

examples :
# upload file to test.scr using timeout 30s
upload T30 test.scr
[initiate file upload in terminal, e.g. CTRL-A Y in minicom]
[wait for timeout or press CTRL-D when finished]

```

## Contents

# Topic DIAG

(diagnostics/debug)

Diagnostics and system utilities

## HELP|?

```

use      : help [V]
brief    : show help info (same as less help.md)
input    : V - verbose output (this file) (optional)
return   : help information
examples :
# show help file
help v
# show command listing
help

```

## HIST|!

```

use      : hist [v] [<id>]
brief    : show command history, execute previous command
input    : v - verbose output (optional, ignored if id specified)
input    : <id> - command ID (integer) (optional)
return   : command history by default, executes queued command if specified

notes    :
[1] up/down arrow keys may be used to traverse the queue

examples :
# show history queue
hist

```

# CON

```
use      : con <port>
brief    : open console to device
          [terminate session using CTRL-D]
input    : port - serial port
          L: LI-COR
          H: Host port
return   : none
examples :
# connect to LI-COR
con li
[do stuff]
[type CTRL-D to exit]
```

# DEBUG

```
use      : debug [<op><mask>]
brief    : show/set per-module debug output flags
          MOD_ACT =0x0001 // cli_impl
          MOD_TMR =0x0002 // timers
          MOD_SCR =0x0004 // script
          MOD_LIC =0x0008 // LI-COR
          MOD_SER =0x0010 // ioserial
          MOD_CFG =0x0020 // config
          MOD_MAIN=0x1000 // main
          MOD_TOKS=0x2000 // command token

input    : op - operator [+:set -:clear =:assign]
input    : mask - hex bit field [0-FFFFFFFF]
return   : debug flags
examples :
# disable debug output
debug =0
SYS_MDFLAGS=x00000000
# enable scr module debug output
debug +4
SYS_MDFLAGS=x00000004
# enable LI-COR module debug output
debug +8
SYS_MDFLAGS=x0000000c
# disable LI-COR module debug output
debug -8
SYS_MDFLAGS=x00000004
# show debug flags
debug
SYS_MDFLAGS=x00000004
```

# PMEM

```
use      : pmem
brief    : show memory pool contents
return   : memory pool contents
examples :
# show memory pool
pmem
```

# PRINT, PRINTLN

```

use      : print <fmt> [<var>...]
brief    : print formatted messages to console using variable expansion and escape
          : character support. Useful for script testing/debugging.

          fmt is a quoted format string, which may include , escaped variables
          (with $ prefix), printf formats

          var are variables (without $ prefix)
          println variant automatically appends CRLF to string

return   : formatted console message (upper case)
examples :

# set CX reg
creg CX0=20

# print CX using default (hex) format
print "$CX0\r\n"
X00000014

# print CX using alternative (decimal) format
print "%ld\r\n" CX0
20

# print CX using alternative (decimal) format (automatically terminate line)
println "CX0:%ld" CX0
CX0:20

```

## VER

```

use      : ver
brief    : show firmware version information
return   : version information
examples :
# show firmware version
ver

```

## UPTIME

```

use      : uptime
brief    : return elapsed time since last power cycle
return   : time since last power cycle
examples :
# show system up time
uptime

```

## RESET

```

use      : reboot
brief    : reboot the firmware
return   : none
examples :
# reset system
reset

```

## HELLO

```

use      : hello [<msg>...]
brief    : print test messages to console
input    : msg - text, variables, registers
          : quoted strings preserve space
          : unquoted strings are space-delimited
          : variables and registers are denoted by $ (e.g. $verbose, $CX2)
          : escape characters are supported in quoted strings [\r\n\t\v\xDD]

return   : 'hello' [args...]
examples :
# print hello message
hello foo $CX0

```

# SLEEP

```
use      : sleep [V]
brief    : enter sleep mode (pending time to next scheduled event)
input    : V - verbose output (displays sleep duration)
return   : ERR_SUCCESS on success (after sleep) or ERR_FAILURE if interval
           not enough time to sleep.

notes    :

examples :
# sleep the processor (if there's time)
sleep
```

# SWEEP

```
use      : sweep <delay_ms>
brief    : turn all IO bits on and then off in order
input    : delay_ms - switching delay
return   : sets all IO bits LO (except serial transceivers)

notes    :
[1] **IMPORTANT** : for hardware testing; disconnect user equipment before using.

examples :
# run sweep with 0.5 sec delay/switch
sweep 500
```

## Contents

# Topic Beta

(deprecated and/or beta features)

---

These features include

---

# CAT

(alternative implementation, not enabled, see notes)

```
use      : cat [T<n>|H<n>] <file>
brief    : show file contents
input    : file - file to show
input    : H<n> - show first n bytes
input    : T<n> - show last  n bytes
return   : file contents
notes    :
[1] there are two cat implementations, this feature is selected by disabling WITH_UI_XCAT
```

# ECHO

(not enabled by default, use PRINT, PRINTLN)

```
use      : echo [<op><dest>] [<msg>...]
brief    : print messages using variable expansion and escape character support
input    : op  - operator [+:enable -:disable]
input    : dest - destination [C:console H:host]
input    : msg  - text, variables, registers
              quoted strings preserve space
              unquoted strings are space-delimited
              variables and registers are denoted by $ (e.g. $verbose, $CX2)
              escape characters are supported in quoted strings [\r\n\t\v\xDD]
return   : expanded message
notes    :
[1] this feature is selected by enabling WITH_UI_ECHO
```

# PROTO

(code prototyping feature)

```
use      : proto (args)
brief    : runs prototype code features [for developers]
input    : args - arguments (varies)
return   : varies
notes    :
[1] this is intended for use by developers; use caution and disconnect user equipment
    before using.
[2] behavior depends on compile-time feature selection. Existing proto features are
    configured in cwgsys.h
[3] see proto.c, proto.h for integration examples
```

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# Topic REF

(reference)

Reference information

## Configuration Variables

| Key         | Type | Value | Description                                           |
|-------------|------|-------|-------------------------------------------------------|
| LOG_RAW     | bool | 1     | log raw LI-COR records                                |
| LICOR_MODEL | i16  | 850   | LI-COR model/protocol                                 |
| SERIAL_N    | u16  | XC024 | hardware serial number                                |
| LI_SPANC    | dbl  | 3.14  | LI-COR SPAN cal value                                 |
| ECHO        | u16  | x0001 | character echo<br>0:none<br>1:cons<br>2:host<br>3:all |

| Key           | Type | Value        | Description                                   |
|---------------|------|--------------|-----------------------------------------------|
| PROMPT        | u16  | x0001        | prompt<br>0:none<br>1:cons<br>2:host<br>3:all |
| CBIN          | str  | CBINyymm.nnn | current cycle log name                        |
| OBIN          | str  | OBINyymm.nnn | current orecord log name                      |
| ZBIN          | str  | ZBINyymm.nnn | current zrecord log name                      |
| SYS           | str  | SYSyymm.nnn  | current syslog name                           |
| CBUF          | str  | CBIN.BUF     | cycle log buffer                              |
| <b>Unused</b> |      |              |                                               |
| VERBOSE       | bool | 0            |                                               |
| LI_CFLAGS     | u32  | X000003FF    |                                               |
| LI_OFLAGS     | u32  | X001F7FFF    |                                               |
| VALVE_TYPE    | u16  | X004D        |                                               |
| AUTO_OUT      | bool | 0            |                                               |
| FOO*          | -    | -            |                                               |

## IO bit indices

| Name       | bit | hex        | binary                                  |
|------------|-----|------------|-----------------------------------------|
| SV0A       | 00  | 0x00000001 | 0000 0000 0000 0000 0000 0000 0000 0001 |
| SV0B       | 01  | 0x00000002 | 0000 0000 0000 0000 0000 0000 0000 0010 |
| SV1A       | 02  | 0x00000004 | 0000 0000 0000 0000 0000 0000 0000 0100 |
| SV1B       | 03  | 0x00000008 | 0000 0000 0000 0000 0000 0000 0000 1000 |
| SV2A       | 04  | 0x00000010 | 0000 0000 0000 0000 0000 0000 0001 0000 |
| SV2B       | 05  | 0x00000020 | 0000 0000 0000 0000 0000 0000 0010 0000 |
| SV3A       | 06  | 0x00000040 | 0000 0000 0000 0000 0000 0000 0100 0000 |
| SV3B       | 07  | 0x00000080 | 0000 0000 0000 0000 0000 0000 1000 0000 |
| SV4A       | 08  | 0x00000100 | 0000 0000 0000 0000 0000 0001 0000 0000 |
| SV4B       | 09  | 0x00000200 | 0000 0000 0000 0000 0000 0010 0000 0000 |
| SV5A       | 10  | 0x00000400 | 0000 0000 0000 0000 0000 0100 0000 0000 |
| SV5B       | 11  | 0x00000800 | 0000 0000 0000 0000 0000 1000 0000 0000 |
| SV6A       | 12  | 0x00001000 | 0000 0000 0000 0000 0001 0000 0000 0000 |
| SV6B       | 13  | 0x00002000 | 0000 0000 0000 0000 0010 0000 0000 0000 |
| SV7A       | 14  | 0x00004000 | 0000 0000 0000 0000 0100 0000 0000 0000 |
| SV7B       | 15  | 0x00008000 | 0000 0000 0000 0000 1000 0000 0000 0000 |
| SV8A       | 16  | 0x00010000 | 0000 0000 0000 0001 0000 0000 0000 0000 |
| SV8B       | 17  | 0x00020000 | 0000 0000 0000 0010 0000 0000 0000 0000 |
| SV9A       | 18  | 0x00040000 | 0000 0000 0000 0100 0000 0000 0000 0000 |
| SV9B       | 19  | 0x00080000 | 0000 0000 0000 1000 0000 0000 0000 0000 |
| PUMP0_DC   | 20  | 0x00100000 | 0000 0000 0001 0000 0000 0000 0000 0000 |
| PUMP1_DC   | 21  | 0x00200000 | 0000 0000 0010 0000 0000 0000 0000 0000 |
| PUMP2_DC   | 22  | 0x00400000 | 0000 0000 0100 0000 0000 0000 0000 0000 |
| PUMP3_DC   | 23  | 0x00800000 | 0000 0000 1000 0000 0000 0000 0000 0000 |
| LICOR_DC   | 24  | 0x01000000 | 0000 0001 0000 0000 0000 0000 0000 0000 |
| ADC0       | 25  | 0x02000000 | 0000 0010 0000 0000 0000 0000 0000 0000 |
| ADC1       | 26  | 0x04000000 | 0000 0100 0000 0000 0000 0000 0000 0000 |
| ADC2       | 27  | 0x08000000 | 0000 1000 0000 0000 0000 0000 0000 0000 |
| XCVR_HOST  | 28  | 0x10000000 | 0001 0000 0000 0000 0000 0000 0000 0000 |
| XCVR_LICOR | 29  | 0x20000000 | 0010 0000 0000 0000 0000 0000 0000 0000 |
| XCVR_CONS  | 30  | 0x40000000 | 0100 0000 0000 0000 0000 0000 0000 0000 |

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