Oxford Cryosystems serial line communication protocols

Cryostream status packet

Note: This information is available in machine-readable form in OxcryoPackets.xml and Cryostream.xml

By default Cryostream issues packets of the following format. If Cryostream receives a SetFormat command then it will switch to issuing extended status packets as detailed below.

```
typedef struct {
    unsigned char    Length;             /* Length of this packet, =
32 (bytes) */
    unsigned char    Type;               /* Status Packet ID = 1 for
standard packet */
    unsigned short   GasSetPoint;        /* Set Temp 100*K */
    unsigned short   GasTemp;            /* Gas Temp 100*K */
    signed short     GasError;           /* Error 100*K */
    unsigned char    RunMode;            /* The current run mode */
    unsigned char    PhaseId;            /* The id of the current
phase - see below */
    unsigned short   RampRate;           /* The ramp rate of the
current phase */
    unsigned short   TargetTemp;         /* The target temperature of
the current phase */
    unsigned short   EvapTemp;           /* Evap temp, 100*K */
    unsigned short   SuctTemp;           /* Suct temp, 100*K */
    unsigned short   Remaining;          /* Time remaining in phase */
    unsigned char    GasFlow;            /* Gas flow, 10*l/min */
    unsigned char    GasHeat;            /* Gas heater, % */
    unsigned char    EvapHeat;           /* Evap heater, % */
    unsigned char    SuctHeat;           /* Suct heater, % */
    unsigned char    LinePressure;       /* Back pressure, 100*bar */
    unsigned char    AlarmCode;          /* Indicates most serious
alarm condition */
    unsigned short   RunTime;            /* Time in minutes system has
been in Run mode */
    unsigned short   ControllerNumber;   /* Controller number, from
ROM */
    unsigned char    SoftwareVersion;    /* Software version */
    unsigned char    EvapAdjust;         /* EvapAdjust vacuum
compensation */
} CryostreamStatus ;
```

Extended status packet

It is recommended to issue a SetFormat command when connecting to Cryostream. If SoftwareVersion is greater than 17 then Cryostream will switch to the Extended format below until it is restarted.

```
typedef struct {
    unsigned char    Length;             /* Length of this packet, =
42 (bytes) */
    unsigned char    Type;               /* Status Packet ID = 2 for
extended packet */
```

```
    unsigned short   GasSetPoint;         /* Set Temp 100*K */
    unsigned short   GasTemp;             /* Gas Temp 100*K */
    signed short     GasError;            /* Error 100*K */
    unsigned char    RunMode;             /* The current run mode */
    unsigned char    PhaseId;             /* The id of the current
phase - see below */
    unsigned short   RampRate;            /* The ramp rate of the
current phase */
    unsigned short   TargetTemp;          /* The target temperature of
the current phase */
    unsigned short   EvapTemp;            /* Evap temp, 100*K */
    unsigned short   SuctTemp;            /* Suct temp, 100*K */
    unsigned short   Remaining;           /* Time remaining in phase */
    unsigned char    GasFlow;             /* Gas flow, 10*l/min */
    unsigned char    GasHeat;             /* Gas heater, % */
    unsigned char    EvapHeat;            /* Evap heater, % */
    unsigned char    SuctHeat;            /* Suct heater, % */
    unsigned char    LinePressure;        /* Back pressure, 100*bar */
    unsigned char    AlarmCode;           /* Indicates most serious
alarm condition */
    unsigned short   RunTime;             /* Time in minutes system has
been in Run mode */
    unsigned short   ControllerNumber;    /* Controller number, from
ROM */
    unsigned char    SoftwareVersion;     /* Software version */
    unsigned char    EvapAdjust;          /* EvapAdjust vacuum
compensation */
    unsigned char    TurboMode;           /* In Turbo mode ? */
    unsigned char    HardwareType;        /* See below */
    unsigned char    ShutterState*;       /* Shutter status or LN level
- see below */
    unsigned char    ShutterTime**        /* Shutter time remaining or
Suspended flag - see below */
    unsigned char    AverageGasHeat       /* Average value of gas
heater */
    unsigned char    AverageSuctHeat      /* Average value of suct
heater */
    unsigned short   TimeToFill*          /* From firmware version 150
this holds the time in mins until the next fill of the LN Dewar*/
    unsigned short   TotalHours;          /* Total number of hours
device has run */
} ExtendedCryostreamStatus ;
```

notes

- chars have a size of 1 byte, shorts have a size of 2 bytes.
- All temperatures are in centi-Kelvin, i.e. 80 K is reported as 8000.
- *800 series systems do not support CryoShutter. From firmware version 110 ShutterState is repurposed to report LN level for systems fitted with an AutoFill. From firmware version 150 the packet also contains an estimate of the time in minutes to the next fill.
- *800 series systems do not support CryoShutter. From firmware version 150 ShutterTime is repurposed to report the Suspended flag indicating a temporary Hold.

Hardware Type

HardwareType is a bit field used to indicate device sub-type according to the table below.

Bit	Meaning
1	Plus system with maximum temperature 500 K (Cryostream, Cobra and Smartstream)
2	System fitted with a CryoShutter (700 series Cryostream and Cobra only)
3	800 series system

4	System fitted with autofill (800 series Cryostream only) (from firmware version 150)

For example, HardwareType = 0 indicates a 700 series Cryostream, HardwareType = 1 a 700 series Cryostream Plus, HardwareType = 4 is an 800 series Cryostream and HardwareType = 5 indicates an 800 series Cryostream Plus.

Run modes

The RunMode member will take one of the following values.

Value	Name	Notes
0	StartUp	Initialising
1	StartUpFail	Initialisation failed
2	StartUpOK	Ready
3	Run	Running
4	SetUp	Set up mode
5	ShutdownOK	Shut down without error
6	ShutdownFail	Shut down with error

Phase ids

The PhaseId member will take one of the following values, not all of which are applicable to all devices. This value only has meaning when RunMode = 1.

Value	Name	Notes
0	Ramp	Temperature changed at a controlled rate to final value
1	Cool	Temperature changed as fast as possible to final value
2	Plat	Temperature held for a defined period of time at the specified value
3	Hold	Temperature held indefinitely at the specified value
4	End	Device is shutdown in a controlled fashion
5	Purge	(Device-dependent) device is warmed to clear a blockage
9	Purge	(Device-dependent) device is warmed to clear a blockage
10	Wait	During a Ramp, device is waiting for temperature to 'catch up' with set point
11	Regen	(Smartstream only) Coldhead is warmed to regenerate sorb
12	Regen	(Smartstream only) Device is cooling down following a Regen

Alarm codes

The AlarmCode member make take the following values, not all of which are applicable to all devices. Over serial line only the most serious (highest level) code is reported.

Each alarm has an alarm level, which is not included in the status packet but may be read from the table below. The levels have the following significance:

- Level 0: No errors or warnings
- Level 1: Trivial condition not indicating a fault
- Level 2: Warning indicating possible fault - machine continues to run
- Level 3: More serious warning indicating fault - machine continues to run
- Level 4: Fatal condition - machine has shut down

Value	Level	Notes
0	0	No errors or warnings
1	1	Stop pressed
2	1	Stop command
3	1	End complete
4	1	Purge complete

5	2	Temp warning
6	2	Pressure warning
7	2	Check vacuum
8	4	Self-check fail
9	4	Flow rate fail
10	4	Temp control error
11	4	Gas type error
12	4	Temp reading error
13	4	Suct temp error
14	4	Sensor fail
15	3	Brownout
16	4	Sink overheat
17	4	PSU overheat
18	4	Power loss
19	4	Coldhead too cold
20	4	Coldhead time out
21	2	Cryodrive not found
22	4	Cryodrive error
23	4	No nitrogen
24	4	No helium
25	2	Vac gauge fail
26	2	Vac reading error
27	2	RS232 error
28	2	Coldhead temp warning
29	4	Coldhead temp error
30	2	Do not open cryostat
31	3	Do not open cryostat
32	2	Unplug Xtal sensor
33	2	Cryostat open
34	4	Cryostat open timeout
35	2	High temp warning
36	4	High temp error
37	3	Cryodrive T sensor fault
38	3	Cryodrive P sensor fault
39	3	Cryodrive low T trip
40	3	Cryodrive high T trip
41	3	Cryodrive low P trip
42	2	Cryodrive high T warning
43	2	Cryodrive low P warning
44	2	Connect gas supply
45	3	Autofill fault
46	1	Autofill about to fill
47	2	Autofill filling
48	4	Collar temp error
49	4	Coldhead error
50	1	Turbo flow
51	1	He selected
52	2	Cryodrive not ready
53	2	Regen required

54	1	Regen complete
55	2	Connect vacuum
56	2	Disconnect vacuum