Black Box / Event Log

A vital troubleshooting tool to minimise your system down time

Similar in principle to the black box recorder found on most aircraft, the event log keeps track of all major system events, faults and most operator actions. Up to 4500 individual events can be stored in SmartPick's non-volatile memory; this represents approximately 200 magnet load cycles for a typical system.

The information contained in the event log presents a detailed picture of a system breakdown that cannot be obtained by any other means; this makes the event log an invaluable troubleshooting tool. In fact there may be no need to call for a technician. With the aid of the event log many problems can be solved quickly via telephone or email.

Accessing the event log can be done wirelessly from a laptop at the factory floor level thanks to SmartPick's built-in Bluetooth module, as shown blow:

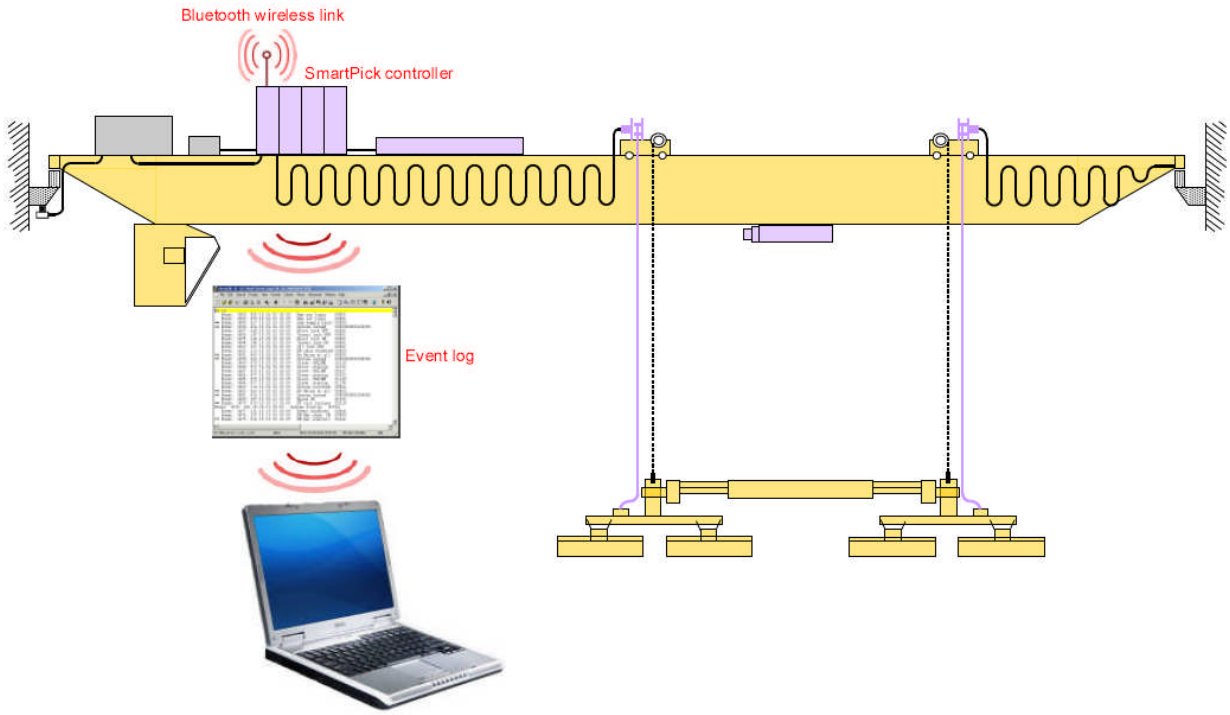

Figure 1: Accessing the event log via a Bluetooth link

A standard serial cable can be also be used instead of the Bluetooth link but this requires access to the crane gantry and SmartPick cabinets. Once the laptop is connected to SmartPick the event log can be easily stored in a file and e-mailed to a Truninger support centre for rapid analysis by a system specialist. Since the event data is stored in a standard text file, no special tools are needed to view the event log.

Inside the event log

All events logged have a unique event number and carry a date/time stamp; it is therefore possible to determine, to the nearest second, exactly when a particular event occurred. Events cover the following types of information:

- Magnet on/off cycles
- Magnet current and battery voltage
- Use of special features such as Partial Drop (order picking)
- Mains failures and battery switches
- Magnet lifting force selected during material handling operations
- Magnet and environment temperature
- State of crane interface signals
- System information: controller restarts, software versions, system id
- Changes to configuration data

Some examples: weak battery

The batteries play a critical role in the operational safety of a magnet system. Battery capacity is therefore tested every time the magnets are switched on and if the capacity is insufficient, power on is aborted. The following event log extract shows an attempt to switch on the magnets when the voltage drop on the battery is too great. Note that events are normally displayed in reverse chronological order, the most recent event appearing first:

```
   Event: 3398: 214 14:29:48 05.10 RB:chrg enabled 00000
   Event: 3397: 145 14:29:44 05.10 Hoist lock OFF 00001
   Event: 3396: 147 14:29:44 05.10 Travel lock OFF 00001
** Event: 3395: 012 14:29:20 05.10 RB:Bat test fail 01999
   Event: 3394: 206 14:29:20 05.10 RB:bat voltage 00101
   Event: 3393: 144 14:29:18 05.10 Hoist lock ON 00001
   Event: 3392: 146 14:29:18 05.10 Travel lock ON 00001
   Event: 3391: 213 14:29:18 05.10 RB:chrg disabled 00000
   Event: 3390: 128 14:29:18 05.10 CB:VG ON 01000
```

The key events we see here are the following:

- Operator gives command to switch on a magnet (event 3390)
- Measured battery voltage just before battery test is 101 Volts (event 3394)
- Battery test fails because of excessive battery voltage drop (event 3395 data ‘999’)

The next example illustrates a slightly different battery test failure scenario (event 1695). Here we see that the measured current during the battery test was almost zero (100mA). This immediately suggests, not a problem with the battery itself, but a possible blown fuse.

```
** Event: 1695: 012 13:33:47 25.03   RB:Bat test fail 13001
   Event: 1694: 206 13:33:47 25.03   RB:bat voltage   00114
   Event: 1693: 144 13:33:37 25.03   Hoist lock ON    00001
   Event: 1692: 146 13:33:36 25.03   Travel lock ON   00001
   Event: 1691: 213 13:33:36 25.03   RB:chrg disabled 00000
   Event: 1690: 128 13:33:36 25.03   CB:VG ON         24032
```

Example of operator mishandling

As most operator actions are logged it is also possible to identify operator handling errors. For example if a load dropped because an operator attempted to transport material using a very low lifting force, this will be visible in the event log. In the following scenario the operator was picking a stack of plates and reported that some plates dropped during the transport phase:

```
Event: 2583: 147 12:30:08 20.12 Travel lock OFF 00001
Event: 2582: 212 12:30:08 20.12 RB:swtch fl cfm 10240
Event: 2581: 150 12:30:07 20.12 End hoisting 00000
Event: 2580: 148 12:30:07 20.12 Start hoisting 00000
Event: 2579: 150 12:30:06 20.12 End hoisting 00000
Event: 2578: 148 12:30:05 20.12 Start hoisting 00000
Event: 2577: 202 12:30:02 20.12 RB:new pl cfm 10240
Event: 2576: 143 12:30:02 20.12 CB:part load set 10001
Event: 2575: 202 12:30:02 20.12 RB:new pl cfm 10240
Event: 2574: 143 12:30:02 20.12 CB:part load set 10002
Event: 2573: 202 12:30:01 20.12 RB:new pl cfm 10240
Event: 2572: 143 12:30:01 20.12 CB:part load set 10005
Event: 2571: 145 12:29:59 20.12 Hoist lock OFF 00001
Event: 2570: 139 12:29:59 20.12 PG power ON 40009
Event: 2569: 139 12:29:59 20.12 PG power ON 30009
Event: 2568: 139 12:29:59 20.12 PG power ON 20009
Event: 2567: 139 12:29:59 20.12 PG power ON 10009
Event: 2566: 199 12:29:59 20.12 RB:Bat test OK 00240
Event: 2565: 206 12:29:59 20.12 RB:bat voltage 00105
Event: 2564: 198 12:29:57 20.12 RB:Bat chrg OFF 00000
Event: 2563: 146 12:29:57 20.12 Travel lock ON 00001
Event: 2562: 144 12:29:57 20.12 Hoist lock ON 00001
Event: 2561: 128 12:29:56 20.12 CB:VG ON 10240
```

Although the load drop itself is not always visible in the event log, by knowing the approximate time of the incident, we can track the operator actions leading up to the load drop:

- Command to switch on magnet groups 1-4 (event 2561)
- Magnet groups 1-4 power on with pre-selected force level 9 (events 2567-2570)
- Operator reduces magnet force level to 5, then 2 and finally 1 (events 2572-2576)
- Operator starts hoisting, triggering automatic switch to full force (events 2578)

Sometimes the interpretation of information contained in the event log can depend on certain configuration settings. In this particular case, the customer had activated in his configuration (not shown here) a feature called Proportional Full Load which adjusts the full load force of the magnets (normally 100%) in proportion to the last partial lifting force selected.

Conclusion: the fact that force level 1 was selected (event 2576) just before switching to full load meant that only approximately 20% of the full lifting force was applied during the transport phase of the operation. The load was therefore not safely secured and explains why some of the plates fell.

Statistics analysis

An important secondary function of the event log is to collect statistics. From the data contained in the event log it is possible to generate graphs and charts for visualising certain aspects of magnet usage. In the example below (Figure 2:) we can see, for a specific system, how magnet power off times varied with each load cycle. This analysis could conceivably be used to help optimise material handling processes in a warehouse or steel production line.

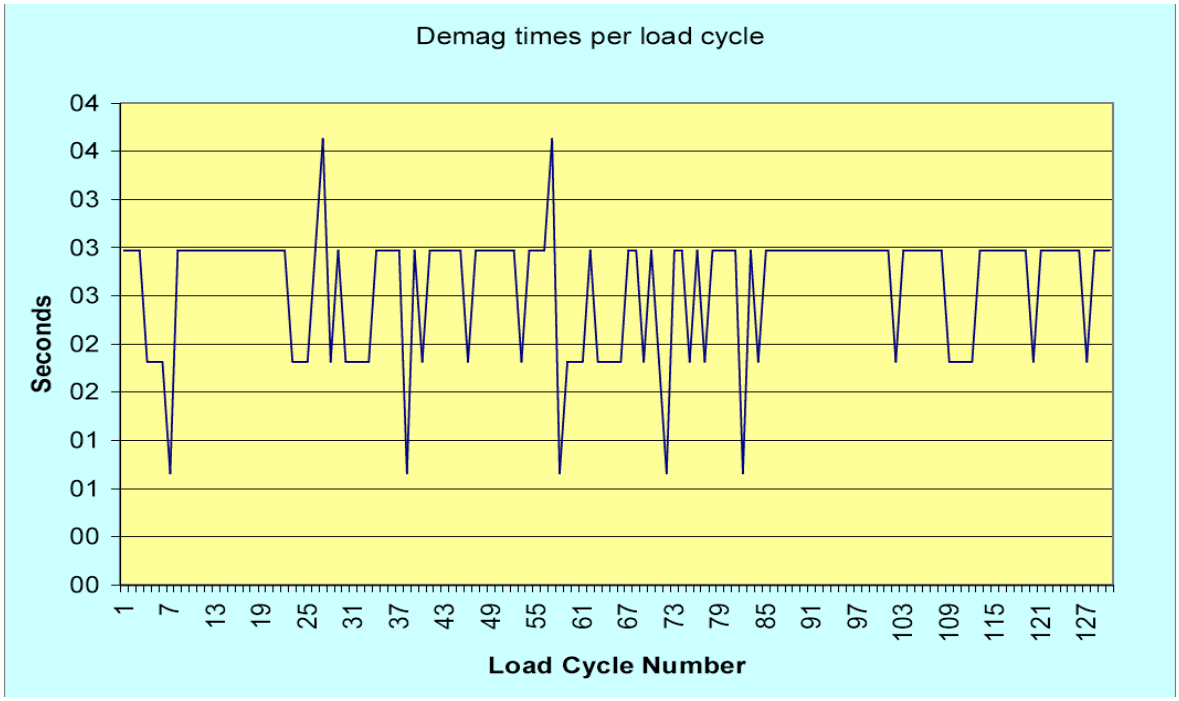

Figure 2: Magnet demagnetisation times