

Create SKF Multilog On-line System IMx Transient Groups for Run up and Coast down Data Collection in SKF @ptitude Observer

Introduction

In vibration analysis, we consider a transient as a non-stationary vibration event due to changes in speed, load or process, e.g., run up or coast down events. This document describes how it is possible to analyze these kinds of events with transient groups in SKF @ptitude Observer using an appropriate configuration depending on customer needs. Additionally, the document recommends a software, firmware and hardware combination in order to have the higher performance during a transient measurement that results in better analysis of these types of events.

Compatibility for higher performance during a transient

The configurations recommended in this document will produce high quality data for analysis of transient events (run up, coast down and over-speed) if the recommended software and hardware versions are used (→ **table 1**).

Table 1

| Item | Version |
|--|----------------------|
| SKF @ptitude Observer Condition Monitoring firmware | 9.0.1 Imx-1.1.pkg |
| If SKF Multilog IMx-M is used: | |
| SKF Multilog IMx-M Protection firmware | 2.0 imxm-214.a48 |

Note that if earlier versions are used, the amount and quality of the transient data could be lower.



Measurement considerations

In order to configure a transient group, we need to consider the next points to get reliable measurements during the transient event:

- The time used by SKF Multilog IMx to process one vibration point in an FFT is from 0.1 to 1 second per channel, depending on the configuration of each measurement point and other features configured in SKF Multilog IMx, like alarming. The worst case will be around 16 seconds to process 16 channels.
- **Check sensor OK status** will increase the measurement/process time. Turn off **Check sensor OK status** when configuring transient groups (→ fig. 1).

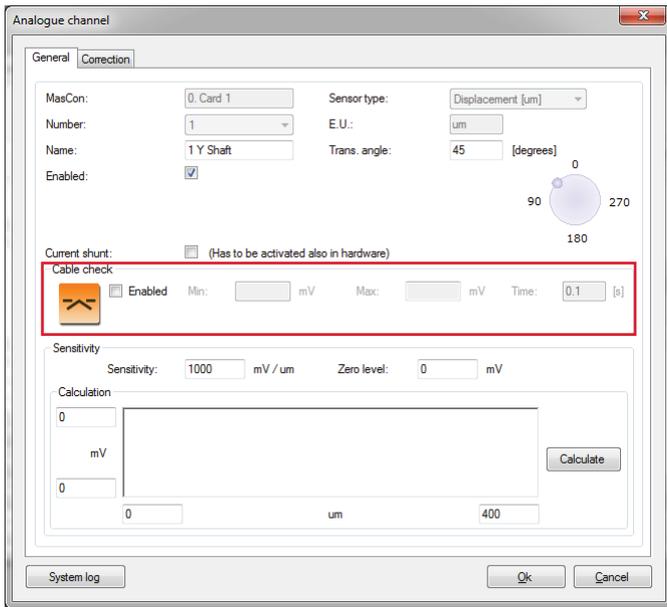


Fig. 1. Turning off "Check sensor OK status" in SKF Multilog IMx analogue channels – SKF @ptitude Observer.

- It is not recommended to have more than one measurement point per channel, especially for **enveloping measurements 1 to 4** or **Digital Peak Enveloping (DPE) measurements** in an SKF Multilog IMx unit that is intended to measure transients. This requires a higher processing time that will affect the transient group measurement by reducing the amount of transient data stored.
- Phase alarms are not active in transient groups.
- The more measurement points used in a transient group, the more time is required from the SKF Multilog IMx to process the information. Four channels will show a better performance than eight channels or sixteen channels.
- SKF Multilog IMx is always measuring and calculating all configured items for each channel. Then the unit saves the values according to the value configured in the **Interval** field in the point property's **Spectra** tab in the "Data storage" section (→ fig. 2).

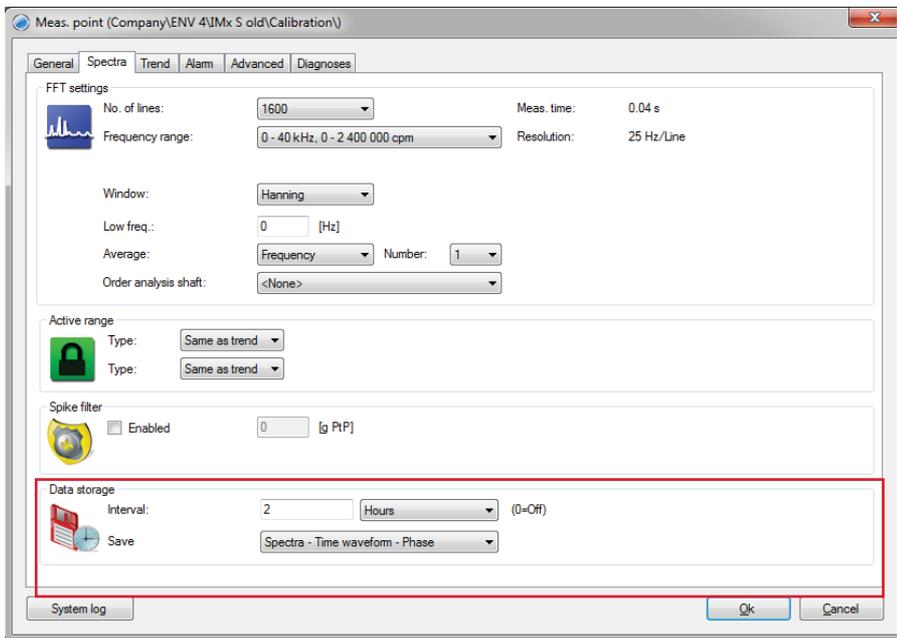


Fig. 2. Measurement point configured to save data every two hours – SKF @ptitude Observer.

- The database size shall not be bigger than 120 GB. If the customer needs more space, they shall use multiple databases and several monitor services that could be installed in the same server (refer to application note **CM3205**, *Multiple databases and monitor services in SKF @ptitude Observer*).
- Customers shall use **harmonic points** when configuring transient groups in SKF @ptitude Observer. A harmonic point is a special point, designed for turbine monitoring, that does order tracking that presents only the harmonic components of a vibration signal (1X, 2X, 3X and 4X).
- Both the amplitude and phase of the harmonic components are available. Since this measurement does not require calculation of the FFT, it is possible to capture essential information at higher rates of speed change.
- During a transient, it is possible to enable or disable the alarm calculation for the harmonic components (1X, 2X and overall) of a harmonic point (→ fig. 3). If alarms are needed, it is recommended to enable the overall alarm for maximum performance.

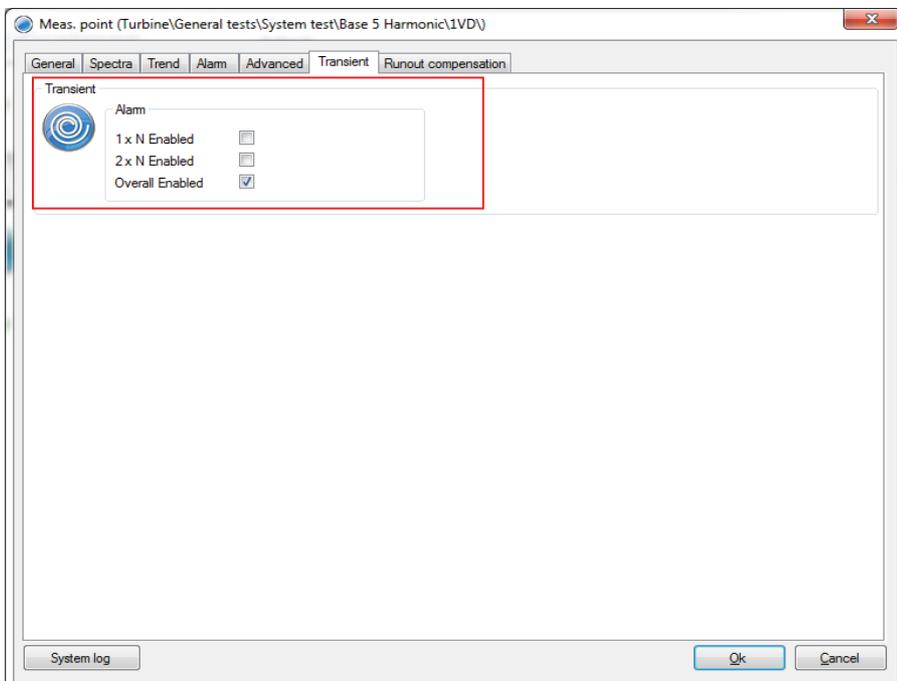


Fig. 3. Transient alarm configuration for harmonic points.

Procedure to create a transient group in SKF @ptitude Observer

This procedure shows how to set up a transient group in SKF @ptitude Observer for SKF Multilog IMx devices and what each configured parameter means. During a transient group configuration, remember the previous points mentioned in the *Measurement considerations* section.

- 1 Go to the **Database** menu and select **Measurement groups**, click **Add**, and then choose "Transient" (→ fig. 4).

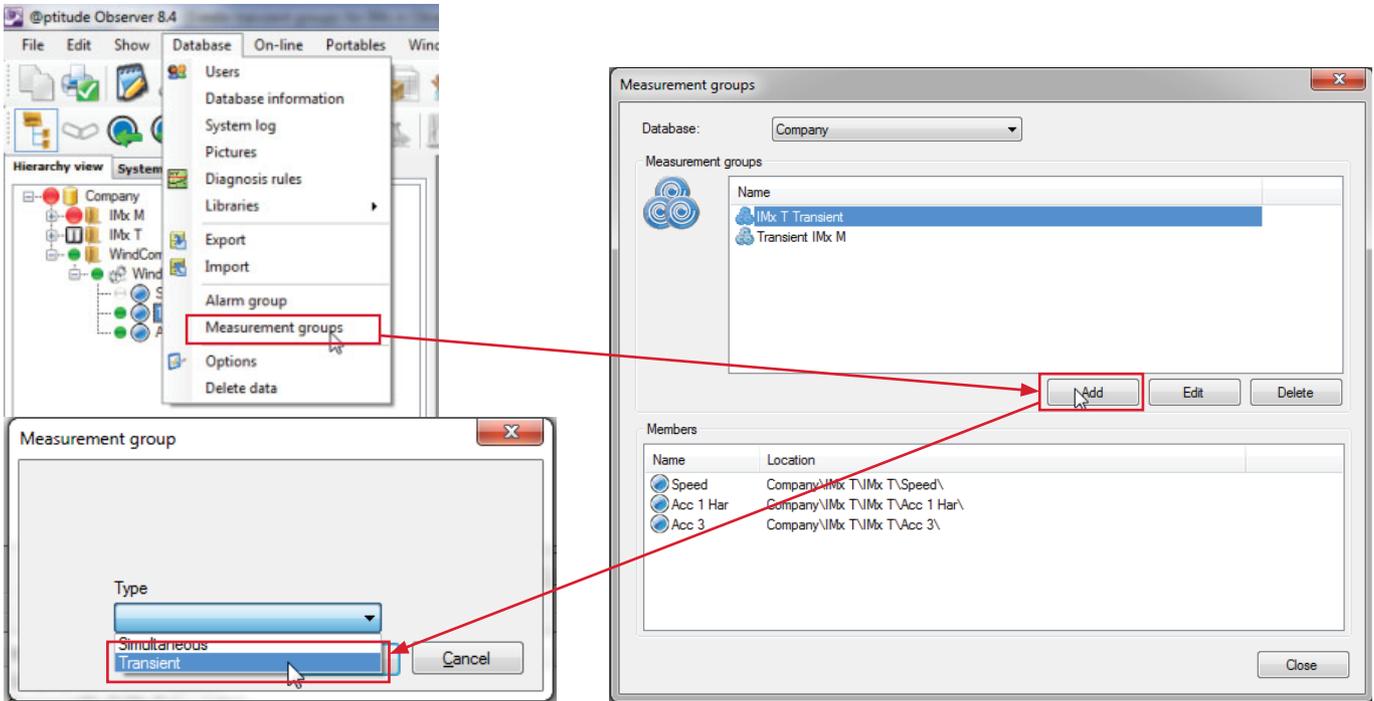


Fig. 4. Creating a new transient group.

- 2 From the **Settings** tab, enter a name and choose the SKF Multilog IMx/MasCon and speed channel (→ fig. 5). **Transient closure time** is the time to remain in the transient after reaching the primary steady state. SKF @ptitude Observer uses this time to make a decision whether a transient is over or not, for example, to decide if two transient events should be glued or should be stored separately. The SKF Multilog IMx unit will start measuring this time after the **Transient state time out** is over (see the description in point #5). Finally, set the simultaneous measurements.

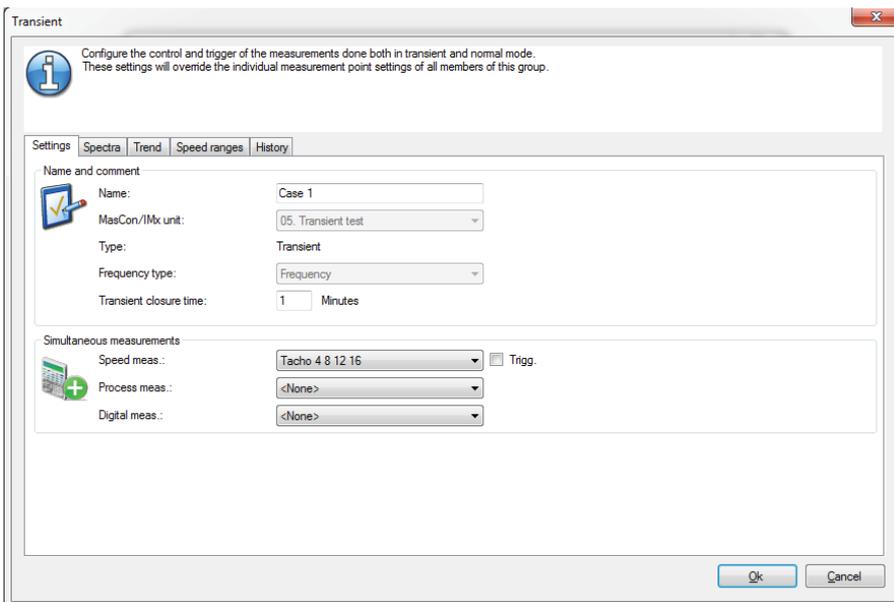


Fig. 5. Name the new transient group.

3 From the **Spectra** tab, set the FFT settings, active range and storage interval for steady state monitoring (→ **fig. 6**).

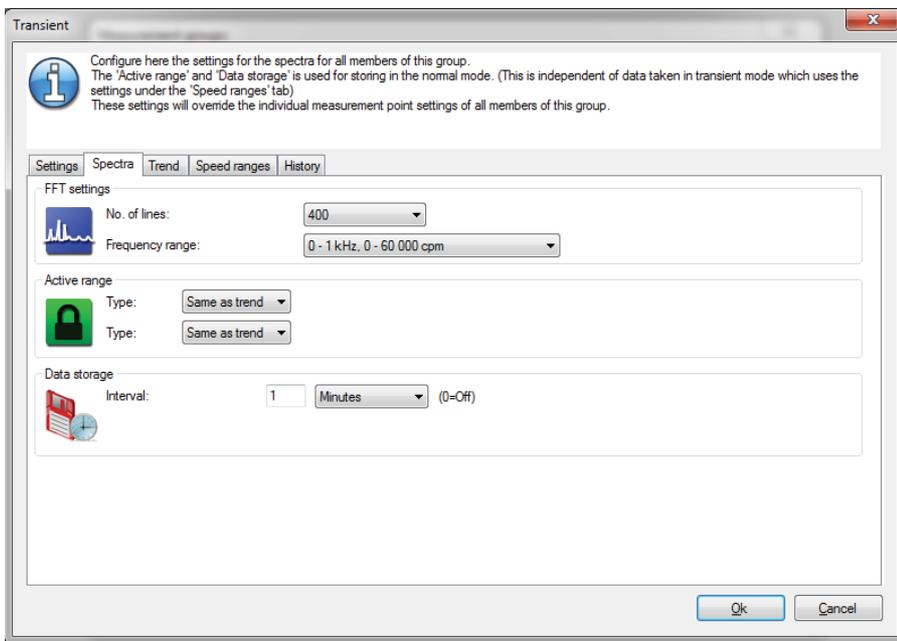


Fig. 6. FFT settings.

It is not recommended to use more than 400 lines. More lines will end up in a longer data collection time between the trend and the FFT values, and this will also vary if the transient is being measured in low or high speed (→ **table 2**).

Table 2

| Spectrum lines | Time between spectrum (s)* | Time between trend values at low speed (s), about 2 000 CPM | Time between trend values at high speed (s) about 10 000 CPM |
|----------------|----------------------------|---|--|
| 400 | 10 | 1,02 | 0,96 |
| 200 | 10 | 0,89 | 0,64 |
| 100 | 10 | 0,80 | 0,60 |

* Configured delta storage for this particular example. The SKF Multilog IMx can process spectra more frequently, but this is not necessary because the analysis can be done using the trend packages that include the dynamic components (1X to 4X and Overall).

4 From the **Trend** tab, choose the active range and storage interval for steady state (→ **fig. 7**).

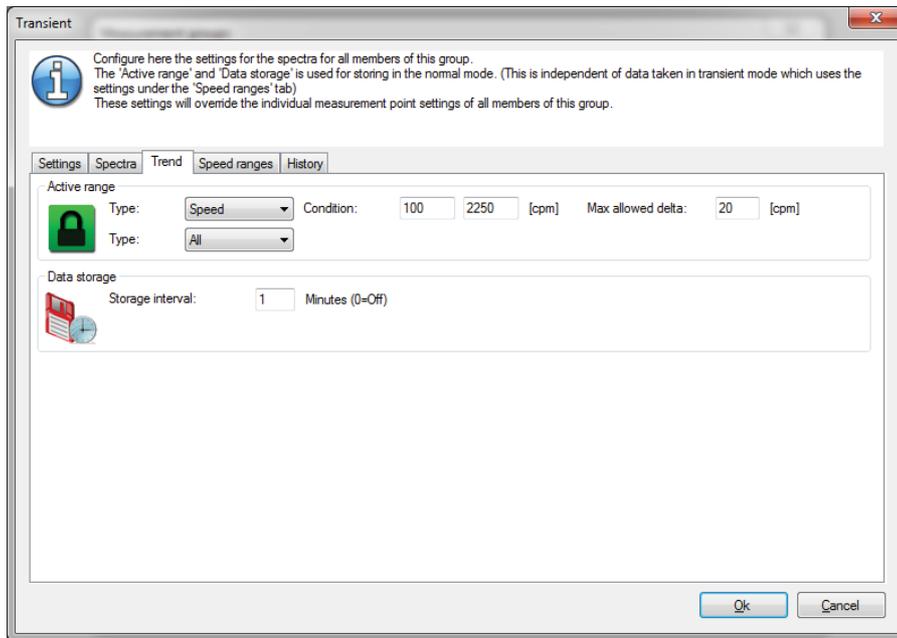


Fig. 7. Trend settings.

5 Go to the **Speed ranges** tab and define the steps according to your needs (→ **fig. 8**). The reason for this is that the **Mean harm** parameter (number of revolutions) needs different values for different speed ranges in order to have better measurement accuracy at low, intermediate and high speeds. Each step will be defined by:

- **Transient state time out:** specifies how long the SKF Multilog IMx will remain sending transient state data after moving from a transient state to a normal state (if the state is stopped, the SKF Multilog IMx will stop sending data). When this time is over, the **Transient closure time** in SKF @plitude Observer will start.
- **Rpm min** and **Rpm max:** are the values used to start and end the step. A minimum speed of 60 RPM can be configured in the steps for the transient. Lower speeds will show inconsistencies in phase measurements.
- **State:** defines if the step will be measured during a normal (steady) state or a transient state.
- **Delta Trend** and **Delta FFT:** they are configured to make the SKF Multilog IMx unit save trend and FFT measurements during the transient mode, according to the speed increase or decrease in revolutions. The SKF Multilog IMx will take the last stored rotational speed value, then it will see the configured delta values and will store data during speed increasing or decreasing if the delta is exceeded. **Delta Trend** shall be 1 CPM and **Delta FFT** shall be zero for maximum data output.

If the user uses delta trend bigger than 1 CPM (for example, 10 CPM), and reduces the spectrum resolution, the data output in low speed may be less (see **table 6** in the *Real example and data obtained* section).

- **Mean ham.** (number of revolutions): This is the time counted in number of revolutions in which the sampling for the measurement is done. A setup of two revolutions at any speed will work as a minimum requirement; if **Mean harm.** is set to only one revolution measurement time, the trend might have large variations. For example, for oil whirl detection at 0.5X, the **overall value** will be much better if the measurement is based on at least two revolutions.

It is also possible to set the number of revolutions using 0.1 to 1 second as a "minimum" time required to calculate a measurement point by checking the time for the shaft to make one revolution, and this is recommended especially for normal speed (steady state). See the example below.

Knowing that the time for the measurement to be taken and processed needs to be at least 0.1 seconds, it is possible to use this time to calculate the number of revolutions. If the steady state is 2 000 RPM, we need to calculate how many revolutions are needed at 2 000 RPM to get to 0.1 second.

- $2\,000\text{ RPM} / 60\text{ s} = 33.33\text{ rev/s}$
- $1/33.33\text{ rev/s} = 0.03\text{ s/rev}$

So one revolution will take 0.03 seconds. As the minimum time for the measurement is 0.1 seconds, we need to configure four revolutions to come over that minimum time for this particular speed.

- $0.03\text{ s} \times 4 = 0.12\text{ s}$

This calculation could be done using 0.1 to 1 second, depending on if a faster update rate or a smoother and more accurate trend is desired.

An example of the setup using 0.1 s for the **Mean harm.** for a machine that has a run up from 0 to 5 000 RPM and an over-speed maximum of 5 100 RPM is show in **table 3**.

Table 3

| Recommended setup | |
|-------------------|-------------------|
| Step (RPM) | Mean harm. (#RPM) |
| 60 – 5 000 | 2 |
| 5 000 – 5 100 | 10 |

- **Max time** and **Max time FFT**: it will save data if **Delta Trend** or **Delta FFT** have not saved anything in the configured time.

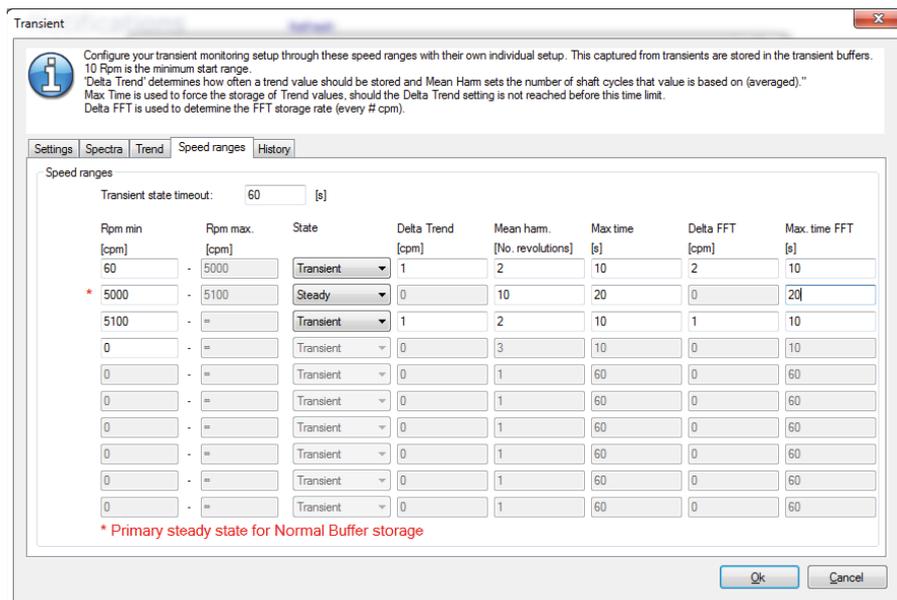


Fig. 8. Speed range setup.

- 6 You always need to configure at least one normal state (steady state) in the steps and an over-speed step after it, as shown in **fig. 8**.
- 7 For over-speed, the number of revolutions could be the same as in the last step before the normal state (two is recommended). During over-speed, it would be good to store measurements faster (by reducing **Delta FFT** and **Delta Trend**) so it can check in detail what it is happening.
- 8 In steady state, it is not needed to store measurements so frequently, so you could increase the storage time (**Max time** and **Max time FFT**) if you want to.
- 9 The **History** tab will be empty until the first measurement happens. Click **OK** (→ **fig. 9**).

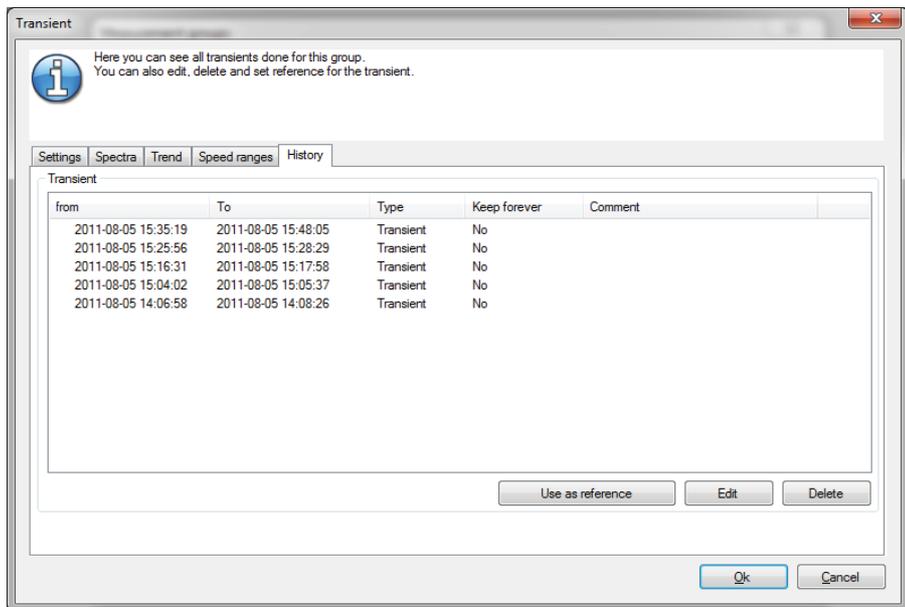


Fig. 9. Historical transients measured.

- 10 The new group will be in the list and you can then click **Close** (→ **fig. 10**).

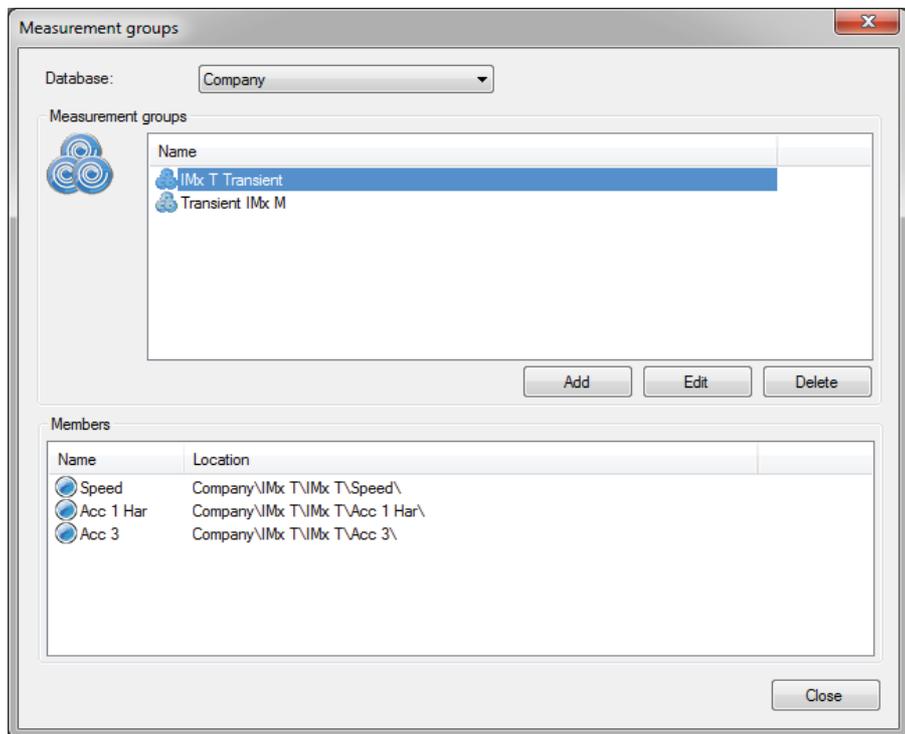


Fig. 10. Measurement groups window.

11 Then in the harmonic measurement point that you want to include in the transient group, choose the transient group (→ fig. 11).

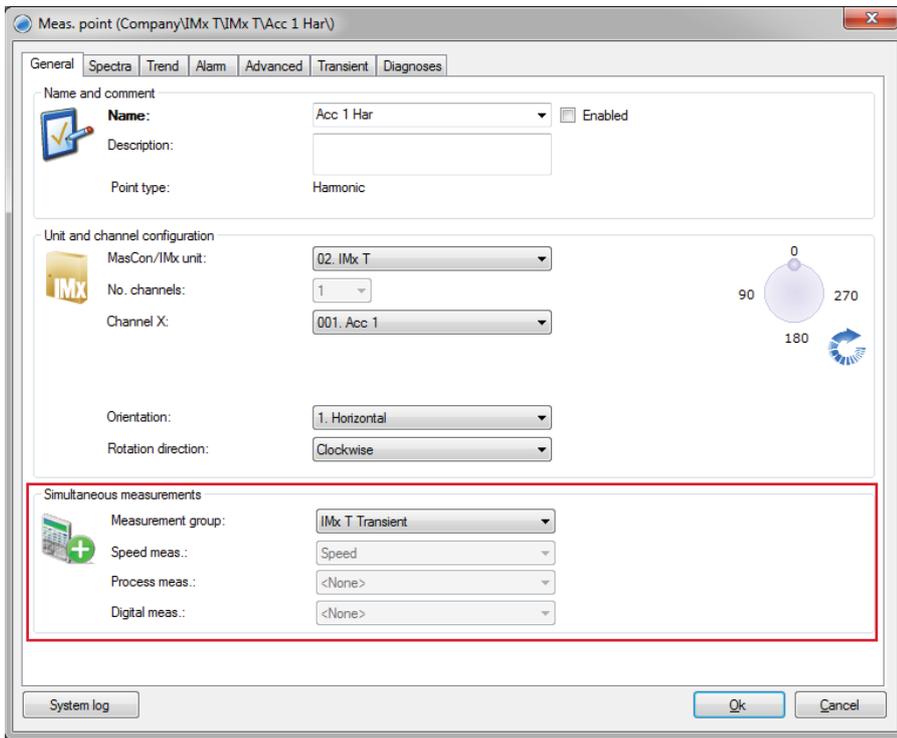


Fig. 11. Measurement point's General tab.

12 When the transients occur, measurements will generate for start up and coast down (→ fig. 12).

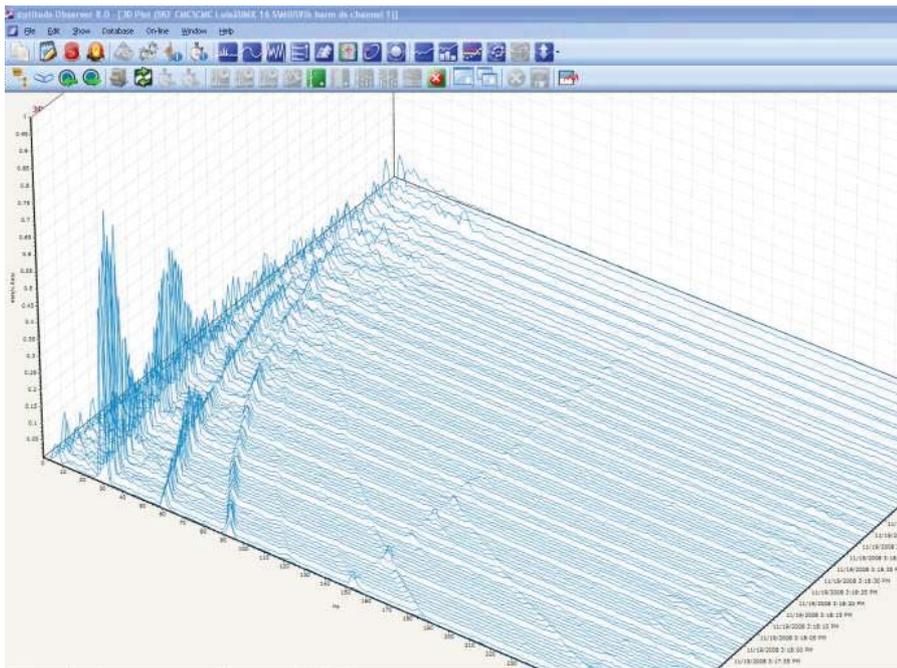


Fig. 12. 3D plot for a start up measurement.

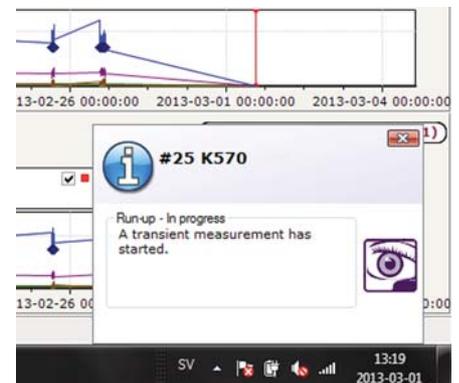


Fig. 13. Indication of a runup started.

13 In order to see the transient measurements at any plot (history, trend, bode, 3D, polar), it is needed to select the transient event from the transient buffer. To do this, with the plot open, click the buffer button, select the "Transient" option in the Buffer area and then click the **Transient** button. In the new window, select the measurement group and transient event, and then click **OK** (→ fig. 14).

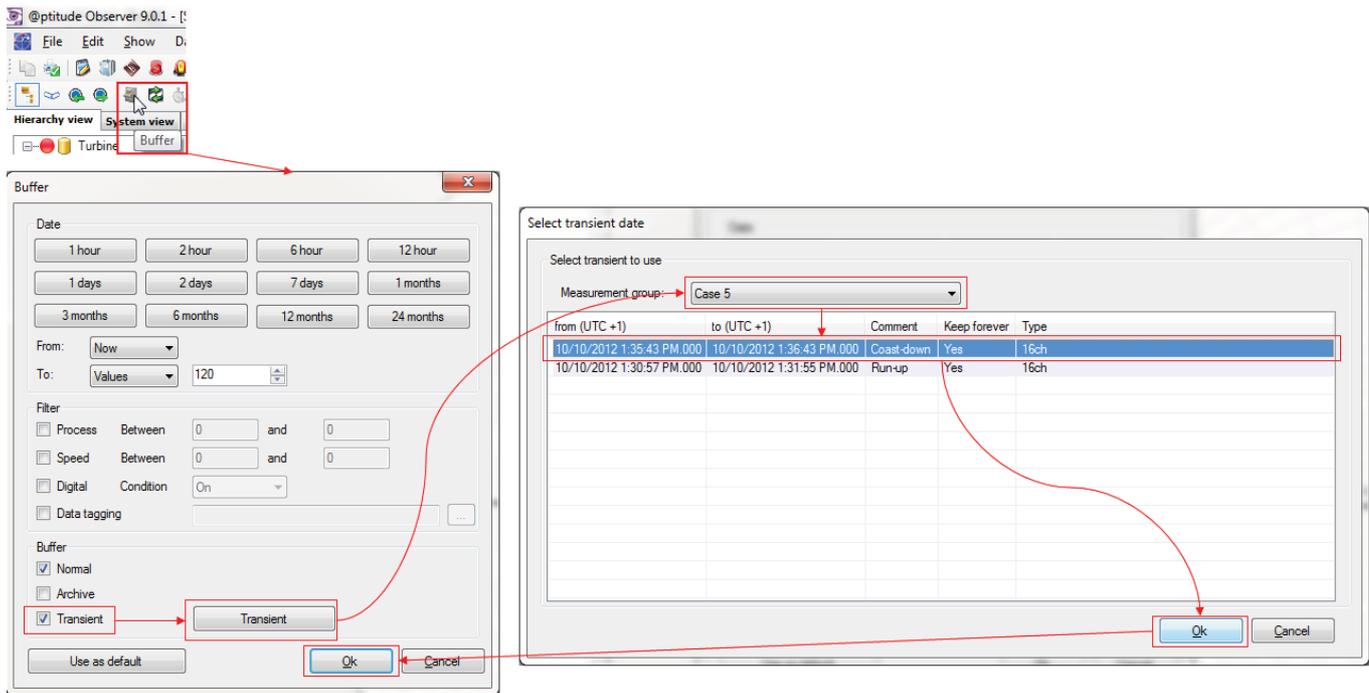


Fig. 14. Select the transient event from the transient buffer.

14 If needed, live plots (trends, bode plots, FFTs) can be reviewed during the transient event with an update rate of 1 s for static data (process values like temperature, pressure, etc.), 2 s for dynamic components (1X to 4X and overall) and 3 s for dynamic FFT data.

15 If needed, with SKF Multilog On-line System IMx-M it is possible to include virtual measurement points in the transient group. As explained in application note **CM 3162, Read Values from Protection Part in Condition Monitoring Part Via Internal Communication with SKF @ptitude Observer**, these measurements come from protection part and their alarm status will also be updated during the transient event.

Real example and data obtained

In this example, we consider a typical system with the next scenario for a multiple transient event (→ table 4).

- Eight critical machines configured for transient
- Two concurrent machines in transient state
- Twelve semi-critical machines configured for steady state, including alarm spectrum collection

It is assumed that the steady state measurements are evenly spread over time:

- 202 total FFT points stored every 10 minutes (0,34 FFT/s)
- 108 total single value points (0,31 trend packages/s)
- Normal data is one FFT and one trend package every 3 s

Table 4

Example of typical system

| Machine description | Radial | Axial | Seismic | Key | RTD Temp | Transient | Rundown (sec) | Runup (sec) | Full scale (orders) | Full scale (Hz) | Max speed 1 (RPM) | Stop speed 1 (RPM) | Max speed 2 (RPM) | Stop speed 2 (RPM) |
|---------------------|--------|-------|---------|-----|----------|-----------|---------------|-------------|---------------------|-----------------|-------------------|--------------------|-------------------|--------------------|
| ATM Comp | 8 | 2 | 2 | 1 | 5 | Yes | 120 | 120 | 12.5 | 1000 | 7600 | 300 | | |
| ATM Comp | 8 | 2 | 2 | 1 | 5 | Yes | 120 | 120 | 12.5 | 1000 | 7600 | 300 | | |
| ATM Comp | 8 | 2 | 2 | 1 | 5 | Yes | 120 | 120 | 12.5 | 1000 | 7600 | 300 | | |
| HP Comp | 32 | 8 | 8 | 4 | 24 | Yes | 420 | 300 | 12.5 | 1000 | 12300 | 300 | 3000 | 300 |
| HP Comp | 32 | 8 | 8 | 4 | 24 | Yes | 420 | 300 | 12.5 | 1000 | 12300 | 300 | 3000 | 300 |
| HP Comp | 32 | 8 | 8 | 4 | 24 | Yes | 420 | 300 | 12.5 | 1000 | 12300 | 300 | 3000 | 300 |
| Propane Comp | 16 | 4 | 4 | 2 | 12 | Yes | 300 | 240 | 12.5 | 1000 | 9800 | 300 | 3000 | 300 |
| Propane Comp | 16 | 4 | 4 | 2 | 12 | Yes | 300 | 240 | 12.5 | 1000 | 9800 | 300 | 3000 | 300 |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| Cond Transfer Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| Cond Transfer Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| Cond Transfer Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |
| ATM Cond Pump | 6 | 0 | 0 | 1 | 5 | No | | | 12.5 | 1000 | | | | |

Table 5 shows a likely distribution of the transient and steady states for the group of machines.

Table 5

Distribution of transient and steady states



For the most critical case where (according to table 1) two machines are in transient mode and the other 12 machines are in steady state, an SKF Multilog On-line System IMx-M will respond to the multiple transient event as shown in table 6 if the configuration shown in fig. 15 is used.

Speed ranges

Transient state timeout: [s]

| Rpm min [cpm] | Rpm max. [cpm] | State | Delta Trend [cpm] | Mean ham. [No. revolutions] | Max time [s] | Delta FFT [cpm] | Max. time FFT [s] |
|--------------------------------------|------------------------------------|-----------|----------------------------------|---------------------------------|---------------------------------|----------------------------------|---------------------------------|
| <input type="text" value="90"/> | <input type="text" value="12300"/> | Transient | <input type="text" value="10"/> | <input type="text" value="2"/> | <input type="text" value="60"/> | <input type="text" value="400"/> | <input type="text" value="60"/> |
| * <input type="text" value="12300"/> | <input type="text" value="15000"/> | Steady | <input type="text" value="300"/> | <input type="text" value="10"/> | <input type="text" value="60"/> | <input type="text" value="300"/> | <input type="text" value="60"/> |
| <input type="text" value="15000"/> | <input type="text" value="="/> | Transient | <input type="text" value="10"/> | <input type="text" value="2"/> | <input type="text" value="60"/> | <input type="text" value="50"/> | <input type="text" value="60"/> |

Fig. 15. Step setup for the two concurrent transient groups.

Table 6

| Delta trend | Spectrum lines | Time between spectrum (s) | Time between trend packages (s), low speed. About 2 000 CPM | Time between trend packages (s), high speed. About 10 000 CPM | Time between trend packages over 4 minutes transient. About 2 000 to 10 000 CPM. Seconds/Values (s) |
|-------------|----------------|---------------------------|---|---|---|
| 10 | 400 | 10 | 1,02 | 0,96 | 240/193 = 1,24 |
| 10 | 200 | 10 | 0,89 | 0,64 | 239/272 = 0,88 |
| 10* | 100 | 10 | 1,02 | 0,75 | 238/185 = 1,29 |
| 1* | 100 | 10 | 0,80 | 0,60 | N/A |

* Due to the speed delta change in combination with a low resolution (100 lines), the SKF Multilog IMx will be forced to skip measurements, and this will end up in a longer time between trend packages. If the maximum performance is desired, a **delta trend** of 1 CPM shall be used.

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