Order tracking measurements with the SKF Microlog Analyzer series and SKF @ptitude Analyst software

Background to order tracking

In collecting vibration measurements on a variable speed machine that changes speed during data collection, it is probable that the spectra collected will not be usable. If a normal FFT is taken while speed variation occurs, the peaks in the spectrum will smear out; they will either be smaller and wider (Figure 1) or completely disappear (Figure 2). This is because the frequency of the forcing frequencies changes with the change in speed. Therefore, it will be difficult to find peaks from bearing frequencies in the normal spectrum collected during a speed variation.

When measuring vibrations on a variable speed machine there is a need to constantly follow the speed and adjust the bandwidth of the spectrum relative to the speed of the machine. This is possible with order tracking in the SKF Microlog Analyzer series and SKF @ptitude Analyst.



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Figure 1. FFT spectrum envelope 3 without an order tracking function.



Figure 2. FFT spectrum envelope 3 without an order tracking function.

The functions behind the order tracking in SKF Microlog Analyzer series

To be able to collect a good FFT, it is necessary to have the same number of samples collected for each revolution independent of the speed. The order tracking function in the SKF Microlog uses the speed measured on each revolution to adjust the number of samples for that revolution afterwards, which means the SKF Microlog takes the original time signal and "translates" the signal into a constant speed signal relative to the actual revolutions of the shaft. Finally, the FFT is calculated based on a time waveform that appears to be in stable speed.

The FFT is calculated based on a specific number of revolutions and not a specific time. For an order tracking point, the SKF Microlog will oversample the signal so that there is still room for a longer time signal if the speed is decreasing. For example if the first revolution of the measurement is at 1000 RPM and for the second revolution has the speed dropped to only 500 RPM, then the second revolution will be twice as



Figure 3. Time signal sample rate normalized for every revolution.

long as the first one. The sampling rate is still the same but there will be twice as many samples for the second revolution (Figure 3).

Therefore, the order tracking function has created a time signal which appears to be at stable speed. Then this time signal goes into normal FFT or into the Enveloping process. The result for the user is a spectrum based on orders of revolution with clear peaks, **(Figures 4 and 11)**.



Figure 4. FFT spectrum envelope 3 with order tracking function and a speed variation from 1800 and 2100 RPM.

How to setup up an order tracking point in the SKF @ptitude Software with SKF Microlog Analyzer

The procedure and suggestions described here are for SKF Microlog series firmware 4.0 or newer and @ptitude Analyst Version 8 or newer.

- Start SKF @ptitude Analyst and check that the SKF @ptitude transaction service is running.
- Create SKF Microlog Analyzer units, channels and hierarchy according to the manual.
- Right-click on a machine and choose Insert Item (Figure 5).
- Select "Microlog Analyzer" as the DAD type and "Vibration" as the Application (Figure 6).
- In the **Point Properties Setup** tab (Figure 7):
 - In Freq type, select "Order track".

- The Low freq cut off is set in Hz.
- Ensure that the **speed tag** is set to None. This is to ensure that the speed is measured at the time of collection of the data.

The most important settings for an order tracking point compared with a fixed span point are End order and number of Lines, where End order is equivalent to Fmax in a standard point.

The maximum frequency will change according to the speed.

🔓 My Hierarc	hies	PC	DINT Properties					23
	Insert Item		Messages No General Setup	otes F Comp	Frequencies Niance Filte	Images Baseline r Keys Setup Log	Band En Overall Spee	velope d Alarm
	Paste Multiple		Full scale:	25	gE	Detection:	Peak to peak	•
	Properties Set Primary		Input mV/EU:	100		Finable ICP	500 to 10K Hz	•
igure 5. Select I	nsert Item from a machine.	ſ	Freq. type:	Order tra	ack 💌	Lines:	12800	•
			Save data:	FFT and	time 🔻	Window:	Hanning	•
DAD/POINT Type	e Selection		Start order:	0		Autocapture:	Always	•
DAD type:	Microlog Analyzer 🗨		End order:	20	Ī	Speed:	1800 RPM	4
Application:	Vibration 💌		Low freq. cutoff:	0	Hz	Averages:	1	
Sensor type:	Accelerometer		Pulses/Rev:	1		Averaging:	Off	•
Units:	gE 🗨		Linear factor:	0		Linear speed units:		
ОК	Cancel Help		POINT:	None			Select.	. 1
igure 6. Select t	he DAD type and application.		Ratio:	1				
						ок	Cancel	Help

Figure 7. Point Properties Setup for a gE measurement point.

How to setup up a order tracking point in the Analyzer module of SKF Microlog Analyzer

The procedure and suggestions described here are for SKF Microlog series firmware 4.0 or newer.

• Go to the Setup menu of the SKF Microlog Analyzer and ensure that the speed is not set to inactive (Figure 8).

Setup		04/11/2014 16:1
Route Mem:	Card	
Timeout:	Off	
Dflt Units:	Metric	
Channel Setup:	Copy To All	
Input Range:	Maximum	
Speed Measurement:	Inactive	
Numerator:	RPM	
Denominator:	Hz	
Filter Entry:	Free Entry	
Trigger:	User	
Ext trig slope:	+	
Module ICP:	Sensor Setting	
Date Format:	DD/MM/YYYY	
Time Zone:	(GMT) Dublin, Edinburgh, Lisbon, London	
Date/Time:	16:17 04/11/2014	
Memory:	-select cmd-	
Route Font:	Big	-
		ОК

Figure 8. SKF Microlog Analyzer Setup.

• Next go to the Analyzer module and choose **New**.



• First choose "Expand" to open all of the existing settings (Figure 9).

Analyzer: New				• 0	04/11/2014 16:30		
Num Channels Sensor: View Signal Y-axis units: Trigger: Trigger Slop Trigger Leve Filter: Freq Range: Detection:	CH1 CMSS 22 Spectrun Accel G Manual e: +ve el: 2.00 V 2Hz 1000.000 RMS	00 h Hz		4			
Acquisition time: 0.400sec							
Use up/down arrows to select menu item. Use right arrow key to change selection. Use left arrow or Fire key to store selection.							
Help	Default	Expand	Save	Start	Back		

Figure 9. Analyzer module function "Expand".

- In the **Point Properties Setup** use the following settings (Figure 10)
 - In x-axis units select "Orders"
 - The selection **Filter** means the **Low freq. cut off** set in Hz or CPM
- Depending on what we choose in the Setup menu (Figure 8)
 - In the **Freq. Range** choose the number of orders

The most important settings for an order tracking point compared with a fixed span point are **End order** and number of **Lines**, where **End order** is equivalent to Fmax in a standard point. The maximum frequency will change according to the speed.

Analyzer: New					04/11/2014 16:	40	
Num Channels: Sensor: Sensor Units: Sensitivity: ICP Supply: View Signal Y-axis units: X-axis units: Trigger: Trigger Slope:	CH1 CMSS g 100.00 On Spectr Accel 0 Orders Manua +ve	CH1 CMSS 2200 g 100.00 mV/g On Spectrum Accel G Orders Manual +ve			2		
Use up/down arrows to select menu item. Use right arrow key to change selection. Use left arrow or Fire key to store selection.							
Help D	efault	Reduce	Save	Start	Back		

Analyzer: New	• 0	05/11/2014 09:	:39			
Trigger Leve Filter: Freq Range: Display Y-axis Detection: Lines: Avg. Type Num. Average Overlap: Window:	el: 2.00 V Off 40.00) : Linear True F 3200 RMS es: 1 0% Hannir	Y PkPk ng				
Use up/down ar Use right arrow Use left arrow o Help	rows to select key to change or Fire key to s Default	t menu item. e selection. store selection Reduce	Save	Start	Back	

Figure 10. Setup of a gE order tracking measurement point in the Analyzer module.



Figure 11. gE order tracking measurement with the Analyzer module.



Order tracking measurement with sensor and tachometer.



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PUB CM3222 EN · April 2015

