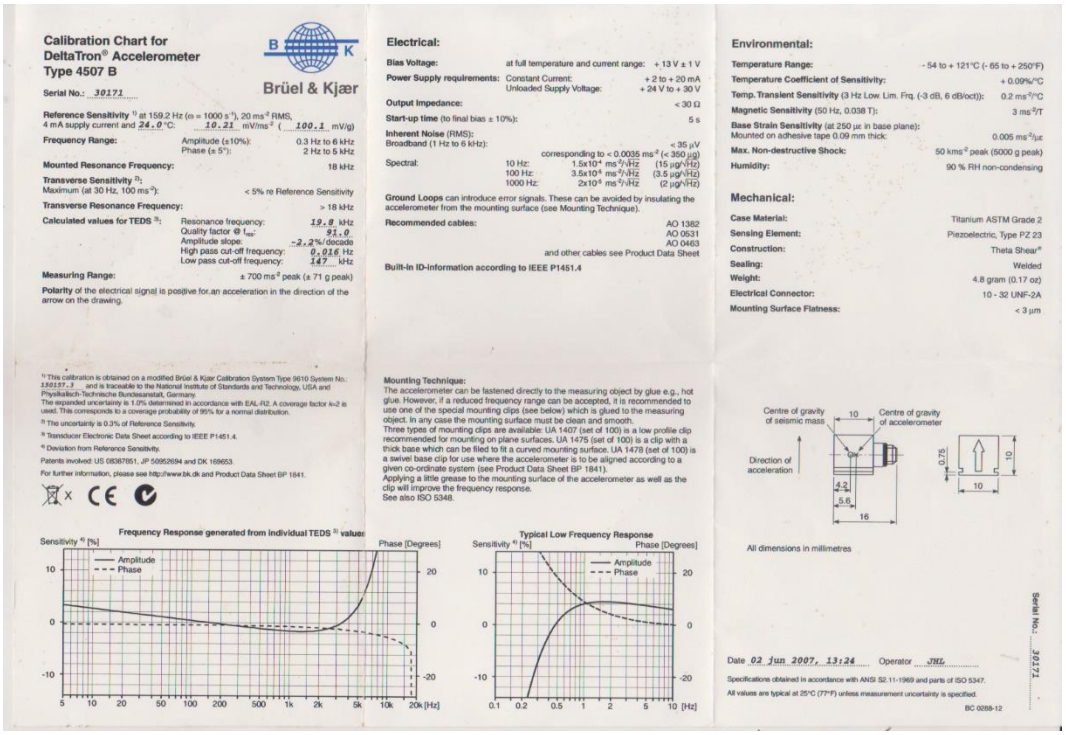
LAMPIRAN

Lampiran 1: Spesifikasi Akselerometer tipe 4507B seri 30171



Calibration Chart for DeltaTron® Accelerometer Type 4507 B

Brüel & Kjær

Serial No.: 30171

Reference Sensitivity [1] at 159.2 Hz (ω = 1000 s⁻¹), 20 ms⁻² RMS, 4 mA supply current and 24.0 °C: 10.21 mV/ms⁻² (100.1 mV/g)

Frequency Range: Amplitude (±10%): 0.3 Hz to 6 kHz; Phase (± 5°): 2 Hz to 5 kHz

Mounted Resonance Frequency: 18 kHz

Transverse Sensitivity [2]: Maximum (at 30 Hz, 100 ms⁻²): < 5% re Reference Sensitivity

Transverse Resonance Frequency: > 18 kHz

Calculated values for TEDS [3]: Resonance frequency: 19.8 kHz; Quality factor Θ f_{res}: 91.0; Amplitude slope: -2.2 %/decade; High pass cut-off frequency: 0.016 Hz; Low pass cut-off frequency: 147 kHz

Measuring Range: ± 700 ms⁻² peak (± 71 g peak)

Polarity of the electrical signal is positive for an acceleration in the direction of the arrow on the drawing.

[1] This calibration is obtained on a modified Brüel & Kjær Calibration System Type 9610 System No.: 150157-3 and is traceable to the National Institute of Standards and Technology, USA and Physikalisch-Technische Bundesanstalt, Germany.
The expanded uncertainty is 1.0% determined in accordance with EAL-R2. A coverage factor k=2 is used. This corresponds to a coverage probability of 95% for a normal distribution.

[2] The uncertainty is 0.3% of Reference Sensitivity.

[3] Transducer Electronic Data Sheet according to IEEE P1451.4.

[4] Deviation from Reference Sensitivity.

Patents invoked: US 08087851, JP 50952694 and DK 169653.

For further information, please see http://www.bk.dk and Product Data Sheet BP 1841.

Frequency Response generated from individual TEDS [3] values

Electrical:

Bias Voltage: at full temperature and current range: + 13 V ± 1 V

Power Supply requirements: Constant Current: + 2 to + 20 mA; Unloaded Supply Voltage: + 24 V to + 30 V

Output Impedance: < 30 Ω

Start-up time (to final bias ± 10%): 5 s

Inherent Noise (RMS): Broadband (1 Hz to 6 kHz): < 35 μV corresponding to < 0.0035 ms⁻² (< 350 μg)

Spectral: 10 Hz: 1.5x10⁻⁴ ms⁻²/√Hz (15 μg/√Hz); 100 Hz: 3.5x10⁻⁵ ms⁻²/√Hz (3.5 μg/√Hz); 1000 Hz: 2x10⁻⁵ ms⁻²/√Hz (2 μg/√Hz)

Ground Loops can introduce error signals. These can be avoided by insulating the accelerometer from the mounting surface (see Mounting Technique).

Recommended cables: AO 1382, AO 0531, AO 0463 and other cables see Product Data Sheet

Built-in ID-information according to IEEE P1451.4

Mounting Technique:
The accelerometer can be fastened directly to the measuring object by glue e.g., hot glue. However, if a reduced frequency range can be accepted, it is recommended to use one of the special mounting clips (see below) which is glued to the measuring object. In any case the mounting surface must be clean and smooth.
Three types of mounting clips are available: UA 1407 (set of 100) is a low profile clip recommended for mounting on plane surfaces. UA 1475 (set of 100) is a clip with a thick base which can be filed to fit a curved mounting surface. UA 1478 (set of 100) is a swivel base clip for use where the accelerometer is to be aligned according to a given co-ordinate system (see Product Data Sheet BP 1841).
Applying a little grease to the mounting surface of the accelerometer as well as the clip will improve the frequency response.
See also ISO 5348.

Typical Low Frequency Response

Environmental:

Temperature Range: - 54 to + 121°C (- 65 to + 250°F)

Temperature Coefficient of Sensitivity: + 0.09%/°C

Temp. Transient Sensitivity (3 Hz Low. Lim. Frq. (-3 dB, 6 dB/oct)): 0.2 ms⁻²/°C

Magnetic Sensitivity (50 Hz, 0.038 T): 3 ms⁻²/T

Base Strain Sensitivity (at 250 με in base plane): Mounted on adhesive tape 0.09 mm thick: 0.005 ms⁻²/με

Max. Non-destructive Shock: 50 kms⁻² peak (5000 g peak)

Humidity: 90 % RH non-condensing

Mechanical:

Case Material: Titanium ASTM Grade 2

Sensing Element: Piezoelectric, Type PZ 23

Construction: Theta Shear®

Sealing: Welded

Weight: 4.8 gram (0.17 oz)

Electrical Connector: 10 - 32 UNF-2A

Mounting Surface Flatness: < 3 μm

All dimensions in millimetres

Date 02 jun 2007, 13:24 Operator JHL

Specifications obtained in accordance with ANSI S2.11-1969 and parts of ISO 5347.

All values are typical at 25°C (77°F) unless measurement uncertainty is specified.

BC 0288-12

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Lampiran 2: Contoh script pengolahan data mentah menjadi plot domain waktu

```
clear
clc

%Direktori tempat data mentah getaran berada
load('E:\Kuliyeah\TAFIXBISMILLAH\impellercavition\rpm_1000\fullv\p
ump15.mat')
y1=data_all(:,1); %diberi nama dengan variabel baru dan berbeda
untuk masing-masing variasi bukaan katup
load('E:\Kuliyeah\TAFIXBISMILLAH\impellercavition\rpm_1200\fullv\p
ump15.mat')
y2=data_all(:,1);
load('E:\Kuliyeah\TAFIXBISMILLAH\impellercavition\rpm_1400\fullv\p
ump15.mat')
y3=data_all(:,1);
load('E:\Kuliyeah\TAFIXBISMILLAH\impellercavition\rpm_1600\fullv\p
ump15.mat')
y4=data_all(:,1);
load('E:\Kuliyeah\TAFIXBISMILLAH\impellercavition\rpm_1800\fullv\p
ump15.mat')
y5=data_all(:,1);
load('E:\Kuliyeah\TAFIXBISMILLAH\impellercavition\rpm_2000\fullv\p
ump15.mat')
y6=data_all(:,1);
load('E:\Kuliyeah\TAFIXBISMILLAH\impellercavition\rpm_2200\fullv\p
ump15.mat')
y7=data_all(:,1);
load('E:\Kuliyeah\TAFIXBISMILLAH\impellercavition\rpm_2400\fullv\p
ump15.mat')
y8=data_all(:,1);



% plot amplitude time domain
figure
subplot(8,1,1)
plot(y1(1:170660))
axis([0 9000 -3 3])
legend('1000rpm')
subplot(8,1,2)
plot(y2(1:170660),'r')
axis([0 9000 -3 3])
legend('1200rpm')
subplot(8,1,3)
plot(y3(1:170660),'g')
axis([0 9000 -3 3])
legend('1400rpm')
subplot(8,1,4)
plot(y4(1:170660),'b')
axis([0 9000 -3 3])
```

```
legend('1600rpm')
subplot(8,1,5)
plot(y5(1:170660),'c')
axis([0 9000 -3 3])
legend('1800rpm')
ylabel('Amplitudo Getaran (mV/g)')
subplot(8,1,6)
plot(y6(1:170660),'m')
axis([0 9000 -3 3])
legend('2000rpm')
subplot(8,1,7)
plot(y7(1:170660),'y')
axis([0 9000 -3 3])
legend('2200rpm')
subplot(8,1,8)
plot(y8(1:170660),'Color',[0,0.4,0.6])
axis([0 9000 -3 3])
legend('2400rpm')
xlabel('Sampel')
```

Lampiran 3: Contoh script pengolahan data mentah menjadi data statistik domain waktu.

```
clc
close all
clear
for d=1:30

signal_in=['E:\MATLAB\impellercavition\rpm_1000\fullv\pump',int2st
r(d),'.mat'];
load (signal_in)
a=data_all(:,1);
Mn1(d)=mean(a);
Rs1(d)=rms(a);
Sd1(d)=std(a);
K1(d)=kurtosis(a)-3;
V1(d)=var(a);
Cf1(d)=peak2rms(a);
end

save('E:\MATLAB\STATIS\full\Mn1.mat')
save('E:\MATLAB\STATIS\full\Rs1.mat')
save('E:\MATLAB\STATIS\full\Sd1.mat')
save('E:\MATLAB\STATIS\full\K1.mat')
save('E:\MATLAB\STATIS\full\V1.mat')
save('E:\MATLAB\STATIS\full\Cf1.mat')
```

Lampiran 4: Contoh *script plotting* data statistik

```
x=[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30];
figure
subplot(2,2,1)
load('E:\MATLAB\STATIS\Full\Sd1.mat')
plot(x,Sd1,'+b','markersize',10);
hold on
load('E:\MATLAB\STATIS\fullrusak\Sd1.mat')
plot(x,Sd1,'+r','markersize',10);
hold on
axis([0 31 0.07 0.27])
legend('\fontsize{10} Impeller normal','\fontsize{10} Impeller
rusak level 1')
title('(a)')
ylabel('Nilai Standar Deviasi Getaran (mV)','FontSize',10)
xlabel('Deret Set Data','FontSize',10)
set(gca,'fontsize',10)

subplot(2,2,2)
load('E:\MATLAB\STATIS\Full\Sd2.mat')
plot(x,Sd2,'+b','markersize',10);
hold on
load('E:\MATLAB\STATIS\fullrusak\Sd2.mat')
plot(x,Sd2,'+r','markersize',10);
hold on
```

```
axis([0 31 0.07 0.27])
legend('\fontsize{10} Impeller normal','\fontsize{10} Impeller
rusak level 1')
title('(b)')
ylabel('Nilai Standar Deviasi Getaran (mV)','FontSize',10)
xlabel('Deret Set Data','FontSize',10)
set(gca,'fontsize',10)

subplot(2,2,3)
load('E:\MATLAB\STATIS\Full\Sd3.mat')
plot(x,Sd3,'+b','markersize',10);
hold on
load('E:\MATLAB\STATIS\fullrusak\Sd3.mat')
plot(x,Sd3,'+r','markersize',10);
hold on
axis([0 31 0.1 0.3])
legend('\fontsize{10} Impeller normal','\fontsize{10} Impeller
rusak level 1')
title('(c)')
ylabel('Nilai Standar Deviasi Getaran (mV)','FontSize',10)
xlabel('Deret Set Data','FontSize',10)
set(gca,'fontsize',10)

subplot(2,2,4)
load('E:\MATLAB\STATIS\Full\Sd4.mat')
plot(x,Sd4,'+b','markersize',10);
hold on
load('E:\MATLAB\STATIS\fullrusak\Sd4.mat')
plot(x,Sd4,'+r','markersize',10);
hold on
axis([0 31 0.1 0.3])
legend('\fontsize{10} Impeller normal','\fontsize{10} Impeller
rusak level 1')
title('(d)')
ylabel('Nilai Standar Deviasi Getaran (mV)','FontSize',10)
xlabel('Deret Set Data','FontSize',10)
set(gca,'fontsize',10)

figure
subplot(2,2,1)
load('E:\MATLAB\STATIS\Full\Sd5.mat')
plot(x,V5,'+b','markersize',10)
hold on
load('E:\MATLAB\STATIS\fullrusak\Sd5.mat')
plot(x,V5,'+r','markersize',10)
hold on
axis([0 31 0.0 0.2])
legend('\fontsize{10} Impeller normal','\fontsize{10} Impeller
rusak level 1')
title('(e)')
ylabel('Nilai Standar Deviasi Getaran (mV)','FontSize',10)
xlabel('Deret Set Data','FontSize',10)
set(gca,'fontsize',10)
```

```
subplot(2,2,2)
load('E:\MATLAB\STATIS\Full\Sd6.mat')
plot(x,V6,'+b','markersize',10)
hold on
load('E:\MATLAB\STATIS\fullrusak\Sd6.mat')
plot(x,V6,'+r','markersize',10)
hold on
axis([0 31 0.1 0.3])
legend('\fontsize{10} Impeller normal','\fontsize{10} Impeller
rusak level 1')
title('(f)')
ylabel('Nilai Standar Deviasi Getaran (mV)','FontSize',10)
xlabel('Deret Set Data','FontSize',10)
set(gca,'fontsize',10)


subplot(2,2,3)
load('E:\MATLAB\STATIS\Full\Sd7.mat')
plot(x,V7,'+b','markersize',10)
hold on
load('E:\MATLAB\STATIS\fullrusak\Sd7.mat')
plot(x,V7,'+r','markersize',10)
hold on
axis([0 31 0.32 0.52])
legend('\fontsize{10} Impeller normal','\fontsize{10} Impeller
rusak level 1')
title('(g)')
ylabel('Nilai Standar Deviasi Getaran (mV)','FontSize',10)
xlabel('Deret Set Data','FontSize',10)
set(gca,'fontsize',10)


subplot(2,2,4)
load('E:\MATLAB\STATIS\Full\Sd8.mat')
plot(x,V8,'+b','markersize',10)
hold on
load('E:\MATLAB\STATIS\fullrusak\Sd8.mat')
plot(x,V8,'+r','markersize',10)
hold on
axis([0 31 0.55 0.75])
legend('\fontsize{10} Impeller normal','\fontsize{10} Impeller
rusak level 1')
title('(h)')
ylabel('Nilai Standar Deviasi Getaran (mV)','FontSize',10)
xlabel('Deret Set Data','FontSize',10)
set(gca,'fontsize',10)
```