Low frequency characteristics of Rogowski Coil Probe and Droop

1. Outline

Introduction

Rogowski Coil Current Probe has, in principle, characteristics of decreasing the sensitivity in low frequency. In low frequency, the frequency that reduces the probe's sensitivity to -3dB is defined as Low-frequency cutoff. When we measure a signal including low frequency elements, we need to be aware that there may be differences between actual current and the result of measurement by Rogowski Coil Current Probe.

Guideline for Low-frequency cutoff and Droop on each model

There is an indicator "Droop", used along with low-frequency cutoff, to show the low-frequency range characteristics. The droops in the following Table 1 is based on the measurement of step-formed pulse waveform.

Table 1 Rough value for Droop

Model Name	Low-frequency cutoff [Hz]	Droop [%/ms]
SS-281A	110	80
SS-282A	65	50
SS-283A	32	25
SS-284A	9	9
SS-285A	6	6
SS-286A	3	3
SS-287A	2	2
SS-293S/L	1	0.8
SS-294S/L	0.8	0.7
SS-295S/L	0.6	0.5
SS-296S/L	0.4	0.35

Definition of Droop and the Characteristics

Droop is defined as the attenuation caused on pulse wave from its rising time to a constant duration thereafter. Rogowski Coil Current Probe uses 1ms for the duration and the Droop's unit is [%/ms]. The higher Low-frequency cutoff becomes, the bigger this ratio becomes.

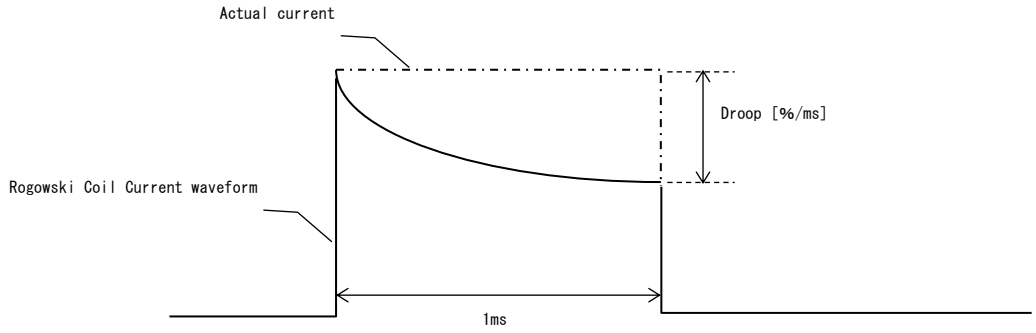
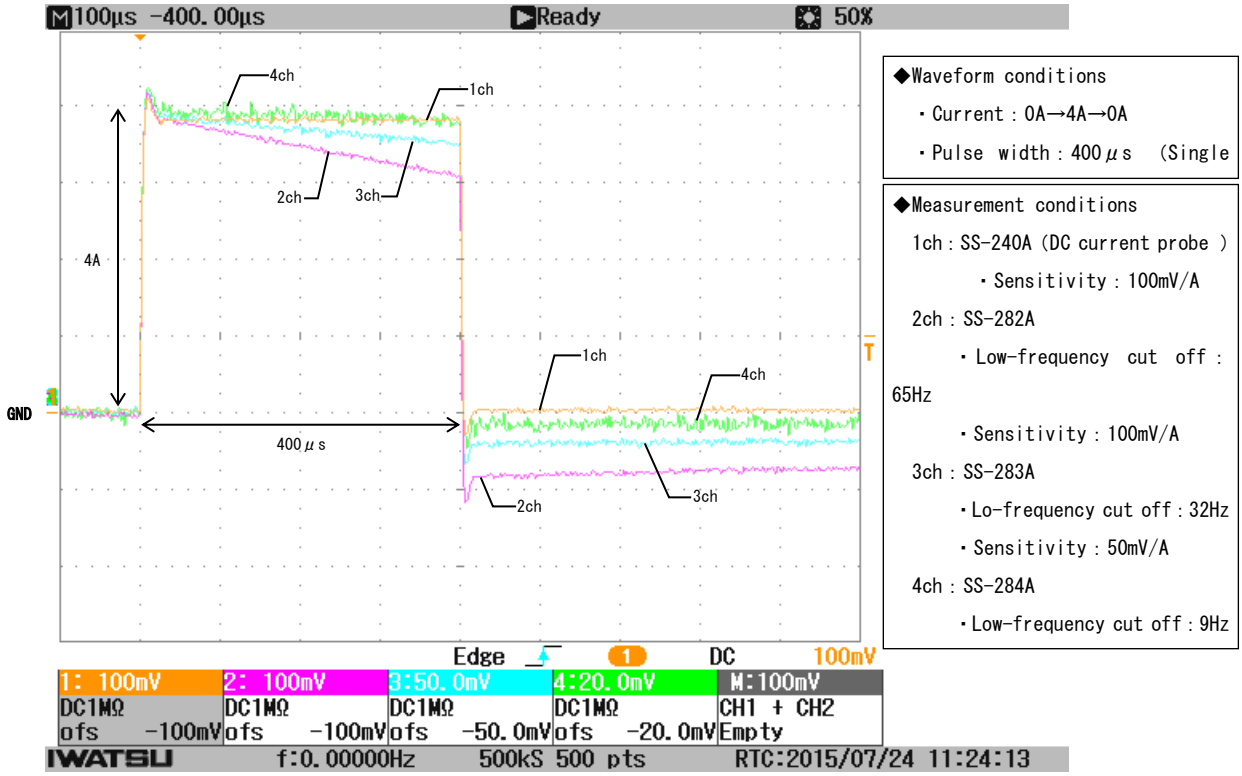


Figure 1 Droop Characteristics

2. Effects on actual measuring waveforms

The following shows the comparison of the measurement result in waveforms between DC current probe (SS-240A) and Rogowski Coil current Probe. The effects of droops can be smaller if you use the probes with low Low-frequency cutoff, but with this probe, sensitivity will be worse. With these in mind, we recommend you select the appropriate probes for your measurement.

2.1. Switching waveforms (Square waveforms)



◆Waveform conditions

・Current : 0A→4A→0A

・Pulse width : 400µs (Single

◆Measurement conditions

1ch : SS-240A (DC current probe)

・Sensitivity : 100mV/A

2ch : SS-282A

・Low-frequency cut off : 65Hz

・Sensitivity : 100mV/A

3ch : SS-283A

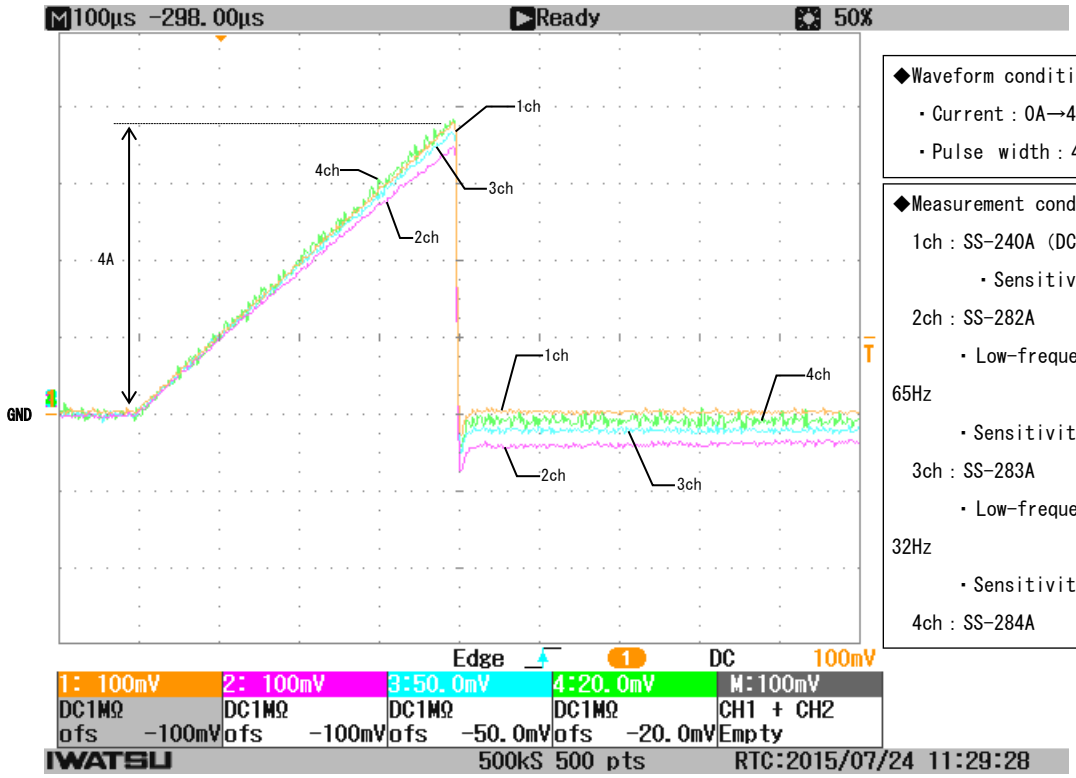
・Lo-frequency cut off : 32Hz

・Sensitivity : 50mV/A

4ch : SS-284A

・Low-frequency cut off : 9Hz

2.2. Switching waveforms (Saw tooth waves)



◆Waveform conditions
- Current : 0A→4A→0A
- Pulse width : 400µs (Single

◆Measurement conditions

1ch : SS-240A (DC current probe)
- Sensitivity : 100mV/A

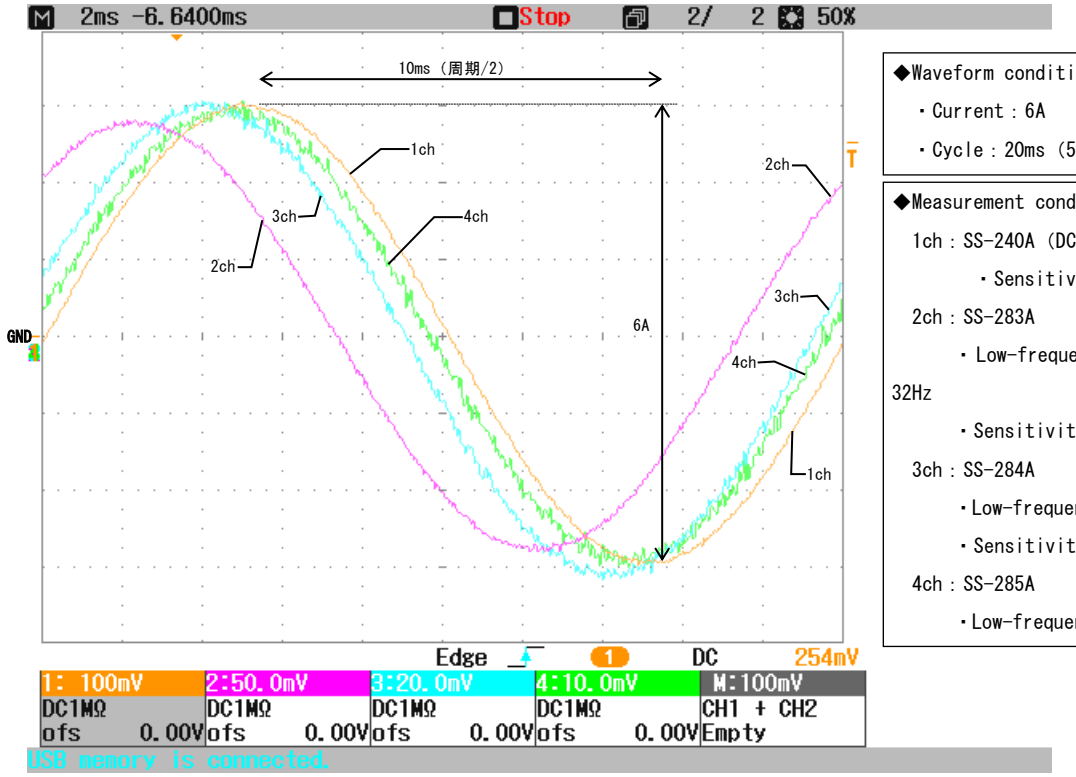
2ch : SS-282A
- Low-frequency cut off : 65Hz
- Sensitivity : 100mV/A

3ch : SS-283A
- Low-frequency cut off : 32Hz
- Sensitivity : 50mV/A

4ch : SS-284A

2.3. Sine Waves

Phase changes along with the lowering amplitude when the frequency of sine wave gets closer to Low-frequency cutoff. The phase will be advanced like general high-pass filter.



◆Waveform conditions
- Current : 6A
- Cycle : 20ms (50Hz)

◆Measurement conditions

1ch : SS-240A (DC current probe)
- Sensitivity : 100mV/A

2ch : SS-283A
- Low-frequency cut off : 32Hz
- Sensitivity : 50mV/A

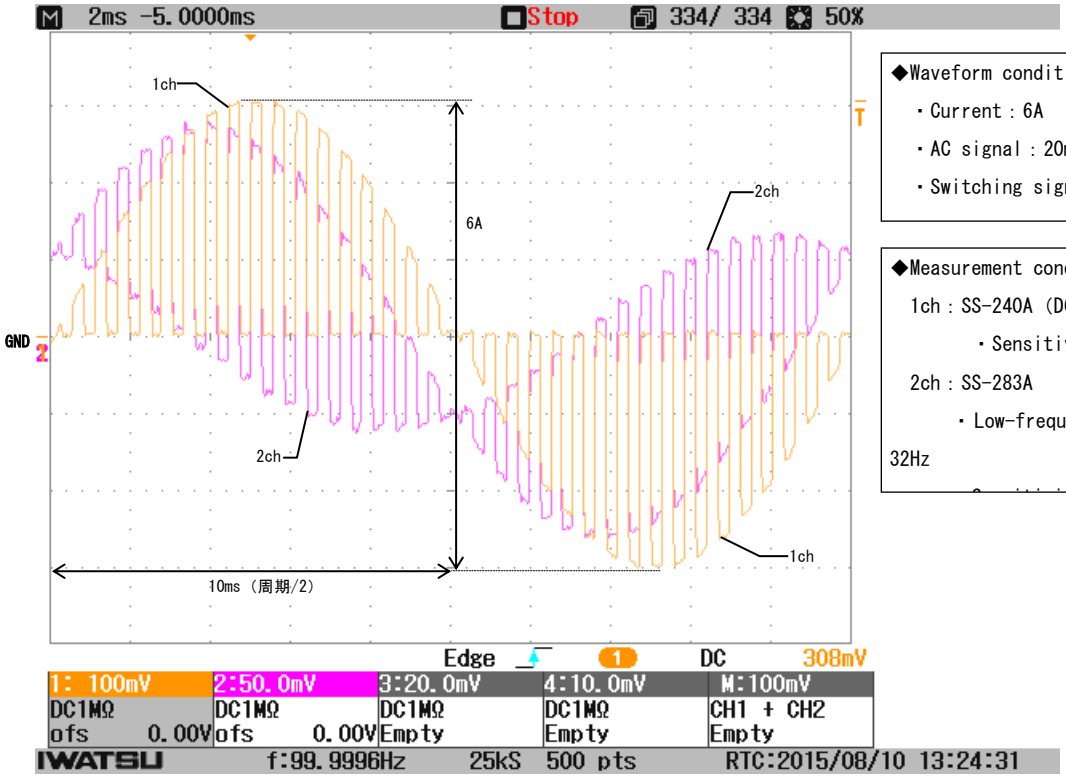
3ch : SS-284A
- Low-frequency cut off : 9Hz
- Sensitivity : 20mV/A

4ch : SS-285A
- Low-frequency cut off : 6Hz

2.4. Switching waveforms (Pulse modulation)

The following ①-③ shows pseudo switching waveforms (Constant Pulse width) of inverter circuits, Switching frequency: 1.8kHz, AC signal frequency: 50Hz. Although Switching frequency is sufficiently-high for Low-frequency cutoff, there are effects on waveforms because they include AC signal element (50Hz).

① When SS-283A (Low-frequency cut off: 32Hz) is used

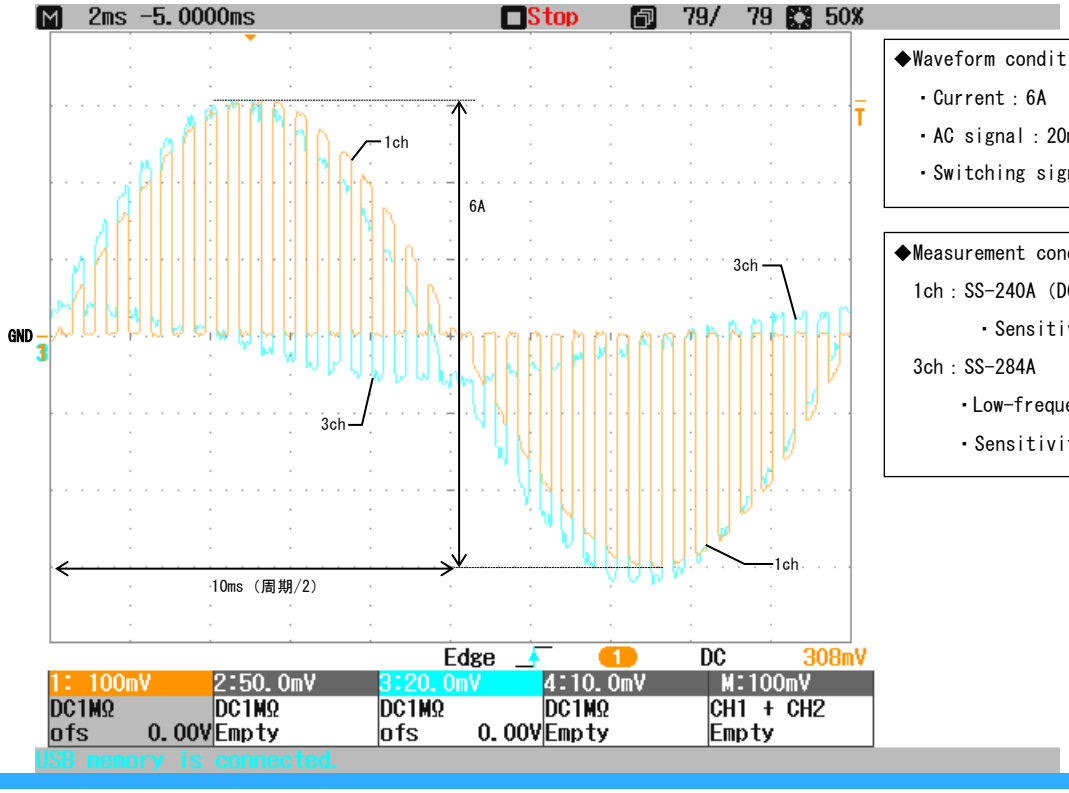


◆Waveform conditions
- Current : 6A
- AC signal : 20ms (50Hz)
- Switching signal : 1.8kHz

◆Measurement conditions
1ch : SS-240A (DC current probe)
- Sensitivity : 100mV/A

2ch : SS-283A
- Low-frequency cut off : 32Hz

② When SS-284A (Low-frequency cutoff: 9Hz) is used

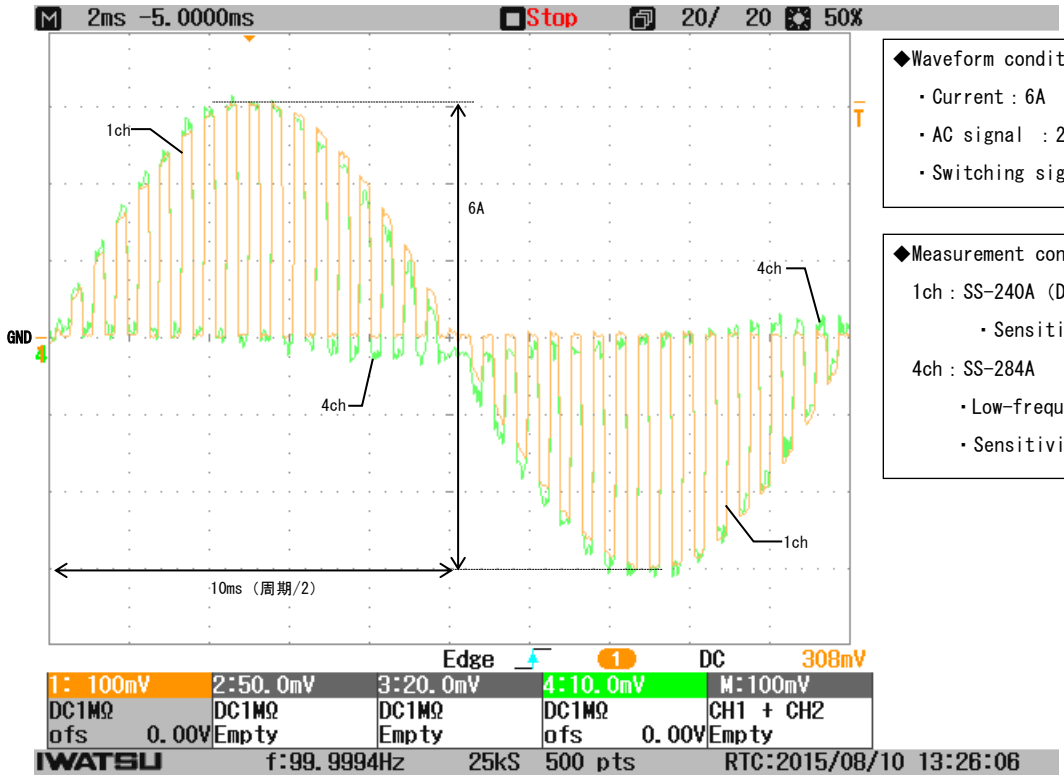


◆Waveform conditions
- Current : 6A
- AC signal : 20ms (50Hz)
- Switching signal : 1.8kHz

◆Measurement conditions
1ch : SS-240A (DC current probe)
- Sensitivity : 100mV/A

3ch : SS-284A
- Low-frequency cut off : 9Hz
- Sensitivity : 20mV/A

③ When SS-285A (Low-frequency cutoff: 6Hz) is used



◆Waveform conditions

- Current : 6A
- AC signal : 20ms (50Hz)
- Switching signal : 1.8kHz

◆Measurement conditions

1ch : SS-240A (DC current probe)

- Sensitivity : 100mV/A

4ch : SS-284A

- Low-frequency cut off : 6Hz
- Sensitivity : 10mV/A

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