

Process and Effort of the Noise Reduction from ACCT Beam Current Monitor

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1. Introduction

The AC-current transformer (ACCT) has been a main beam current measurement system of the 100-MeV proton linear accelerator and its beamline. ACCT (AC-current transformer) is typical non-destructive current measurement method, can measure the macro-pulse current of the charged particle beam without any disruption [1]. Then, ACCT is superior to measure the beam pulses longer than tens of sec with high sensitivity and strong voltage signal, even down to 1 mA. However, the output signal of ACCT have been vulnerable to the electric noise intrinsically, such as RF, switching electricity and so on. In this paper, the effort and process for the reducing the noise from ACCT will be introduced.

2. Noise reduction of ACCT

2.1 Current ACCT system

The ACCT consist of toroidal sensor head and its electronics, which is contained in the external box. They are interconnected with a twisted pair cable fitted with BNC connectors and common-mode filters. The specification of ACCT which is installed at proton beamline, is described as table 1.

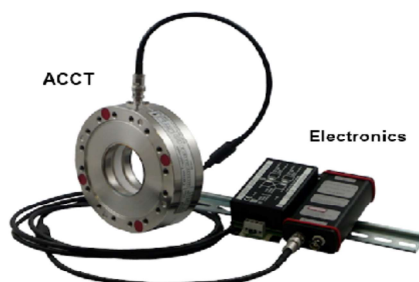


Fig. 1. ACCT with electronics

Table 1. Specification of the ACCT system

Full scale range	Factory preset range
Ratio accuracy error	<0.% FS
Lower cutoff	< 0.1% FS
Droop	<2% /ms
Upper cutoff	1 MHz
Rise time	350ns (10 ~ 90 %)
Noise at 10 mA F.S.	1.5 uA rms
Form factor	In-flange (6" CF)

2.2 Typical electric noise from ACCT

Figure 1 shows the typical electric noise from the output signal of the ACCT in the experiment room environment. Two kind of the electric noise was observed. One is the slow electric noise with 60 Hz induced by the commercial 220V AC power. Another is the 3 MHz high frequency electric noise, which can be an obstacle for beam current monitoring.

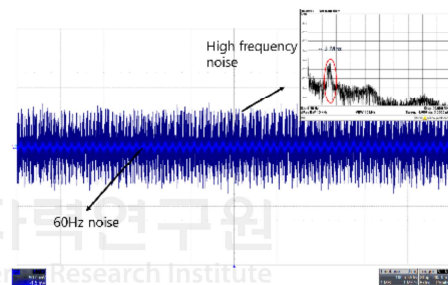


Fig. 1. Typical electric noise from ACCT output

To reduce such a high frequency noise, we try to ground the outer conductor of the input and output connector of ACCT electronics each other as shown as Fig. 2. Then, 3 MHz noise was disappeared.

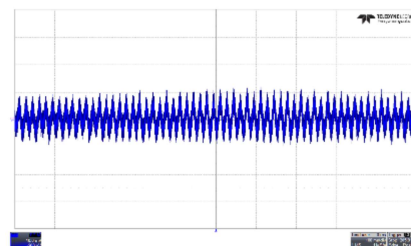


Fig. 2. High frequency noise reduction from ACCT

2.3 The electric noise from High Power RF system

The real ACCT beam current system was installed at the accelerator tunnel and klystron gallery. Figure 3 shows the electric noise of ACCT which was observed at the klystron gallery, as you can see 60 kHz electric noise from the all ACCT's. The 60 kHz noise can be induced by the modulator system, which drive the high power RF klystrons. Such an electric noise was considered inevitable at the particle accelerator; it was not easy to reduce.

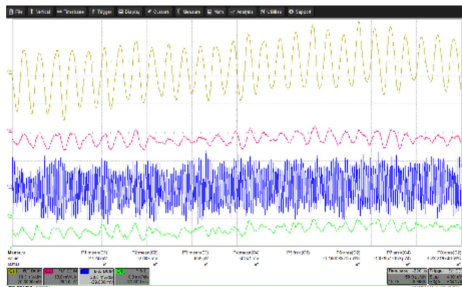


Fig. 3. The electric noise from ACCT in the klystron gallery.

2.4 Noise reduction by RF shield box

The beam current monitoring with ACCT have been accompanied with the unwanted RF noise for a long time. Recently, we try to install the ACCT electronics into the RF shield box to reduce the RF noise as shown as Fig. 4.

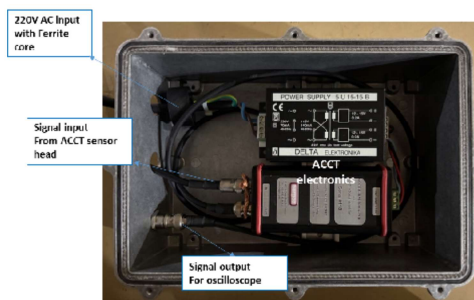


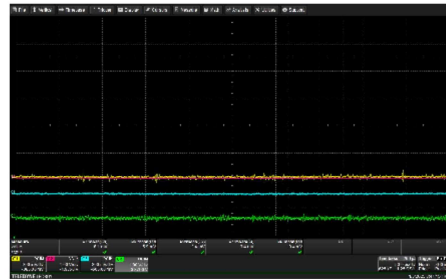
Fig. 4. RF shield box configuration for noise reduction

We apply the ferrite core to 220V AC input and then the outer conductor of input and output connectors ACCT electronics, the outer of the RF shield box is grounded to the main electric ground in the building.

The Figure 5 shows the output signals from ACCT's before and after applying to RF shield enclosure to the ACCT electronics. The 60 kHz electric noise, which come from the high power RF system, was reduced quietly.



(a) before



(b) after

Fig. 4. The noise reduction by the RF shield enclosure

3. Conclusions

ACCT is the main instrumentation for beam current monitor at the 100 MeV proton accelerator. We have been suffered to the electric noise induced by high power RF system. Finally, we could reduce the noise by grounding input and output connectors of ACCT electronics and applying the RF shield enclosure. The effort and progress for the noise reduction was introduced briefly.

REFERENCES

