



EUROPEAN
SPALLATION
SOURCE

ESS AD Technical Note
ESS/AD/0040

Accelerator Division

Anders J Johansson

Timing System Frequency Choice for ESS

4 May 2012

Timing system frequency choice for ESS

Anders J Johansson

This is a short report on the choice of main clock frequency for the timing system in order to facilitate having the timing system and the RF system phase locked to each other.

ESS frequency plan

The main parameters of the ESS accelerator are:

| | |
|--------------------------|------------|
| RF frequency Low energy | 352.21 MHz |
| Bunch frequency | 352,21 MHz |
| RF Frequency High energy | 704.42 MHz |
| Pulse frequency | 14 Hz |
| Pulse length | 2.86 ms |

ESS will have one central oscillator, which will generate the phase reference of the RF parts and the master clock for the timing system. Thus a common time base and phase can be established between the different systems at ESS.

Timing system event clock frequency

The choice has been made to use the MRF timing system for prototyping. It takes an input signal between 50 MHz and 1.6 GHz. The event clock frequency is settable between 50 MHz and 125 MHz.

The bunch frequency of ESS is $f_{\text{bunch}}=352.21$ MHz. If we choose 1 period of the event clock rate to be 4 periods of the bunch frequency, we get an event clock frequency of $f_{\text{event}}=f_{\text{bunch}}/4=88.0525$ MHz.

The timing system can generate one event per period of f_{event} . By setting the number of events in one 14 Hz period to 6 289 464 we get a pulse repetition frequency of 14.000 000 636 Hz.
(Error to 14 Hz is 0.045ppm)

Setting the number of events during a pulse to 251 830 gives an actual pulse length of 2.859 998 ms.
(Error to 2.86 ms is 0.699 ppm)

The granularity of the timing signal is $1/f_{\text{event}}=11.357$ ns.

A 1 pps (Pulse Per Second) signal can be generated without any approximation. Thus the choice of timing frequency has no influence of the accuracy of the real time clock (RTC).