BNB Accelerator Control Signal Availability [Draft]

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The purpose of this document is to describe how each signal relevant to the timing of the BNB experiments is generated and where these signals are available. Presently, the signals common to MiniBooNE, LArTF, SciBooNE, and SBN Near and Far Detector buildings is the Tevatron clock (TCLK) and Main Injector beam sync (MIBS) clock. A copy of the Booster RF (BRF), Booster extraction sync (BES), and both the BNB and NuMI resistive wall current monitor (RWM) signals will be available on fiber at all active experiment buildings in the future.

TCLK is generated by a front end called the timeline generator (TLG) and is broadcast at 10 MHz to each accelerator service building. Main control room personnel change the timeline based on the requests of the experiments and the needs of the HEP program. The TCLK signal carries individual encoded commands known as events, which have hexadecimal values $00 to $FF. The control devices which are decoding these specific commands are programmed to treat each event accordingly.

As an example, a $1D is known systematically as a Booster reset for BNB beam. Most devices are waiting to decode the $1D command and are programmed to take action following a delay of so many RF cycles (RFC), nanoseconds, microseconds or milliseconds, or some combination of these, which is often settable via ACNET. The controls system used to read the voltage on a beam loss monitor is triggered on the $1D and is set to delay its reading by 47 ms.

MIBS is like TCLK in that the signal carries encoded commands that devices are decoding, but the frequency of MIBS is locked to the Main Injector RF, which sweeps from 52.8 MHz to 53.1 MHz every cycle. The MIBS $74 event is broadcast when 120 GeV protons are extracted from Main Injector to NuMI. The TCLK $A9 is generated from the MIBS $74 and is broadcast over the TCLK link.

TCLK and MIBS are patched into a repeater at each service building and require an IRM with appropriate decoders to use these signals. TCLK decoders offer eight channels which can be configured to output eight different TCLK events, each with a settable pulse width and delay in milliseconds. MIBS decoders offer four channels which are hard coded to output the MIBS $74 and have settable pulse widths and delays in microseconds.

BRF and BES originate in the Booster low level RF (LLRF) room and are converted from copper to TTL at the MI-12 service building with a fiber transmitter. BRF sweeps from 37.7 MHz to 52.8 MHz at a rate of 15 Hz. The BES signal indicates that 8 GeV protons will potentially be extracted from Booster, regardless of what their downstream destination is. BES is broadcast regardless of whether beam is permitted and present or not.

BES and BRF are used to generate a delayed BES signal from a Tawzer module in the MI-12 service building. The number of BRF cycles by which BES is delayed is settable on ACNET.

BNB beam travels through an RWM which picks up the 1.6 us long, 52.8 MHz signal of the 81 individual 18.9 ns wide bunches that come with each batch sent to the BNB target. That signal is digitized in the MI12 service building.

The NuMI RWM picks up the 11.1 us long, 53.1 MHz signal of the 486 individual 18.8 ns wide bunches that come with each batch sent to the NuMI target and is treated similarly at MI-60.

TCLK, MIBS, BRF, BES and both RWM signals will later be available to the MiniBooNE, LArTF, MINOS, and SBN Near and Far Detector buildings through a multi-functioning timing unit (MFTU). All of these signals can be carried from their local outputs on LEMO-terminated copper cables.

The MFTU decodes TCLK and four other possible inputs, such as MIBS, BRF or BES. Output channels can be programmed to decode 16 different TCLK events to arm the device. The other input signals can be used to delay and trigger the MFTU output signal. These delays are settable on ACNET.

TTL to Fiber Transmitters and Fiber to TTL Receivers exist to support the MFTUs. The raw RF and TTL signals are coming from their various origins and arrive at the MI-12 service building.

These signals will be converted to fiber in a TTL to Fiber Transmitter and sent to each of the experiment service buildings, where they will be converted back to TTL with a Fiber to TTL Receiver to be useful to the MFTUs.