L.13: Development of precision programmable nano-second time delay generation unit (TDU) for Copper Vapour Lasers (CVL)

Low jitter precision time delay generator is essential to synchronize Copper Vapour Lasers in a MOPA configuration. A multi-channel, ultrafast, low jitter, programmable nano-second delay generator is developed, with selectable step of 250 ps to 5 ns and jitter less than 300 ps. The output delay signal can drive co-axial line up to 30 meters. In order to operate this unit in presence of high electromagnetic interference, delayed output is also provided on optical port. Cascading multiple channels / units is also possible for providing longer delay in the range of micro seconds. The unit is developed using a micro controller and programmable delay generators (DS1023). The functional block schematic of the unit is shown in Fig.L.13.1 and photograph of developed units are shown in Fig. L.13.2.

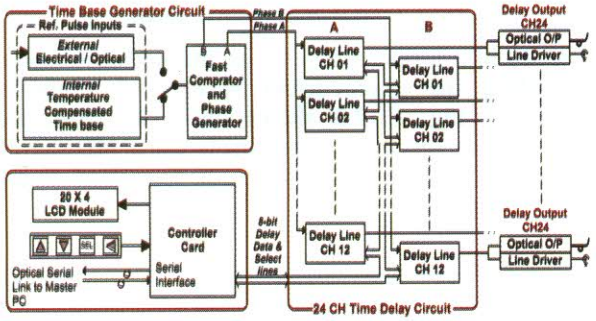

Fig. L.13.1: Functional block schematic of TDU

The unit can be configured in 2 to 24 channels. A 6 channel delay generator card is developed for these units. Temperature compensated, stable internal time base was specially developed which operates at 4 to 20 kHz with pulse-width of 2μs and is used as reference. The modules have very low frequency drift of ±40 ppm /°C and 0.1% per volt over supply voltage. To enhance long term performance and stability, delay signals are isolated and transmitted using optical fibers to the trigger unit of the HV power supply. The units can work standalone or as slave controlled remotely on optical serial link through PC based GUI application LAYA-24, developed using MS visual studio (Fig.L.13.3).

Fig. L.13.2: Time Delay Units of 2- and 24-channels

Salient features/ specifications of TDU:

1. Rise / fall time (Tr): 3 ns.
2. Time Jitter: < 300 ps. (@ trigger level of 2V w.r.t. reference pulse).
3. Output channels: 2 / 6 , extendable up to 24
4. Resolution: min. 250 ps, standard 1ns, max.5 ns.
5. Range: standard 0 to 255 ns, up to 1275 ns.
6. Remote operations on serial fiber link.
7. Sized in 2U/ 3U, Euro standard 19 inch rack mountable. Tailor made for lower configurations.
8. Front panel LCD and key pad for local settings (password protected).
9. Temp. Compensated internal time base (4-20 kHz).
10. External trigger - electrical or optical (up to 1 MHz), User selectable positive / negative edge triggering.
11. TTL compatible output on BNC and Optical output for each channel on standard SMA Port.
12. Integral non-linearity: <1% of FS.

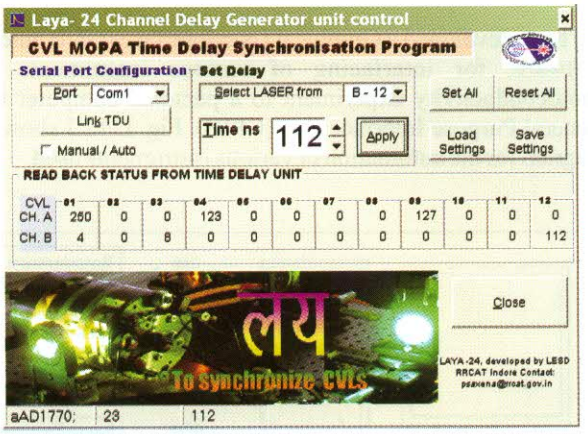

Fig. L.13.3: Master control GUI -LAYA -24 for TDUs

Fig. L.13.4 shows typical output pulses delayed in step of 5 ns. Non-linearity of the measured delay is < 1% of span. This waveform is taken with 50 Ω terminations. It shows that Tr is < 3 ns and peak to peak jitter is < 300 ps.

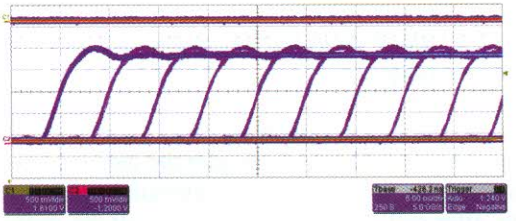

Fig. L.13.4: Delay output pulses with step delay of 5 ns

The unit is an import substitute and over 20 units are in operation with CVL MOPAs at RRCAT, Indore and BARC, Mumbai.

Reported by:
H.S. Vora (vora@rrcat) and P. Saxena