Superconducting RSFQ-based microelectronic circuits have been studied for applications with clock speeds above 40 GHz.

A new fabrication process based on Nb/AlOx/Nb tri-layer process with Molybdenum as a resistor material and anodization for junction insulation has been developed.

This process was implemented at a commercial foundry at HYPRES Inc. – the only superconducting electronics foundry service provider in the US. While standard HYPRES process has been using Josephson junctions with 1kA/cm$^2$ current density and minimum junction size of 3 µm, the new process implements junctions with critical current densities up to 8.0 kA/cm$^2$ and a minimum junction size of 0.8 µm- limited by projection lithography.

The speed of a typical RSFQ circuit scales as a square root of the critical current density enabling the new process to boost the speed by at least a factor of two.

A number of complex digital circuits have been demonstrated working in excess of 40 GHz. Background is a picture of one of the most complex superconductor chips - All Digital Receiver (ADR chip)- designed, fabricated and tested at HYPRES inc.