Metrological measurements using programmable Josephson Voltage Standard

Paper Summary

SUMMARY PASSAGE 1

Introduction

In 1962 Brain Josephson predicted the intrinsic behavior of the cooper pairs when they are tunneled trough a thin barrier of insulator installed between two super conductors [1] and in 1963 his theory is proofed [2,3]. After these dates many experiments [4] are performed to prove the frequency voltage relation which is given in Equation.1. Several experiments have shown that the equation is independent from geometry and material of the junction, power of the microwave and magnetic field [4].

SUMMARY PASSAGE 2

Vj=N.F.H/2E

With the measurements in Sections 3.1 and 3.2 the quantum state of the standard is presented. With the measurements in Section 3.3 the traceability to quantum standard for dynamic ADC characterization is presented. This ADC will be used in resistive voltage divider characterization in the QuADC [11] project.

SUMMARY PASSAGE 3

Components Of The System

This process is carried out with an optical transceiver system. In addition, the system consists of a 28-bit multimeter (voltmeter, ADC) that checks whether or not the generated voltages are at quantum accuracy, a computer and software that calculates the DAC voltage and loads the voltage information into the DACs and receives and evaluates the ADCs measurement data. The system is shown in Figure 2 .

SUMMARY PASSAGE 4

Static Adc Characterization:

Also when the ADC gain m is found by fitting the measurement results as in Equation 7, the uncertainty of the gain is less dependent on the circuit parameters: k is the number of steps of the waveform shown in Fig.3, m is the gain of the ADC and n is the offset of the fitted linear curve. For easiness V UUT_DMM =V R ; V UUT_i =V i can be denoted. Equation 8 is the definition of the gain using least square error method for fitting.

SUMMARY PASSAGE 5

Solid State Voltage Standard (Ssvs) Calibration:

In TUBITAK UME, SSVSs are traceable to Conventional JVSs. The comparison of the installed PJVS system with the another Josephson system rather than directly, using the SSVS as a transfer standard is preferred. For this reason, superconducting and solid state standards are interconnected on a thermal block as shown in Figure 8.

SUMMARY PASSAGE 6

Fig.8 Comparison Of The Pjvs And Ssvs

The 20-sample symmetric square wave is produced whose amplitude is quantized to the last calibration value of the SSVS. The purpose of this is to reduce the uncertainty of the voltmeter gain by reducing the difference voltage between the two voltage standards to a minimum. The low potentials (black wires) of the two standards are short-circuited with one of the shorts on the block.

SUMMARY PASSAGE 7

Dynamic Iadc Characterization

Integrating ADC (IADC) is most commonly used ADC in metrology. PJVS standard is used to investigate how the ADC gain changes depending on the dynamic conditions in which the input signal changes rapidly and the integration period decreases while the sampling frequency increases. In Figure 2, the generation of the quantum signal is synchronized with the 10 MHz clock of the ADC.

SUMMARY PASSAGE 8

Conclusions

In this study, Programmable Josephson Voltage Standard established in UME was used in static and dynamic ADC characterization and SSVS calibration. Model functions of the measurements were created including the stray components in the measurement circuit. Uncertainties of the measurements were evaluated according to the model functions.