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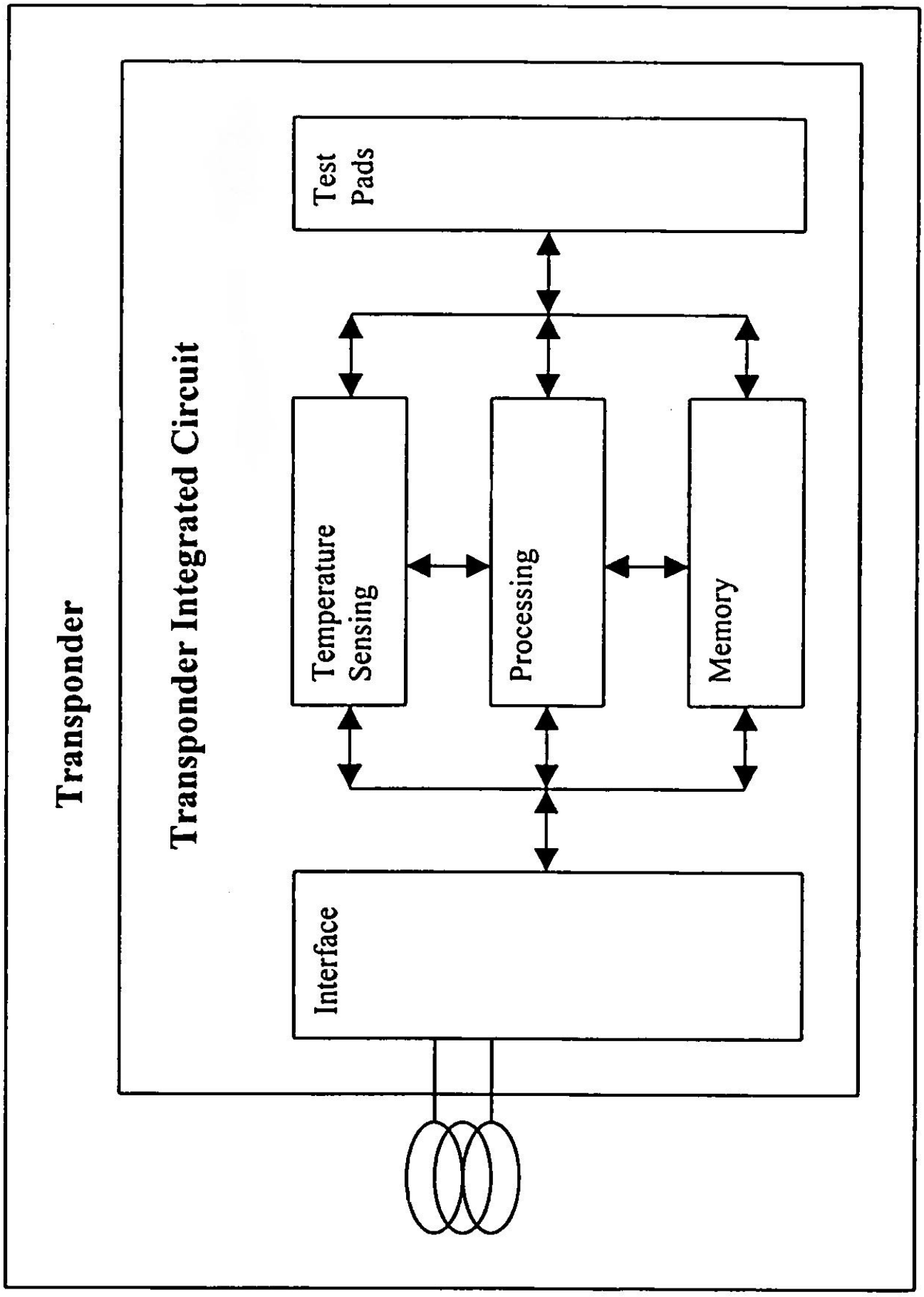
(54) Titel: **BiChip V1 Implantable NFC and Smart Thermometer**

(57) Sammendrag:
BiChip V1 (version 1) implantable passive RFID-NFC transponder chip with a smart thermometer for health monitoring through in-vivo body temperature monitoring, that can store identification and access control data like opening house and car doors, or checking in at work places, and various forms of contactless payment which require authentication processes. Use of BiChip V1 for Health Monitoring and Health Status Verification during COVID-19 and other pandemics The smart thermometer in BiChip V1 is able to accurately monitor temperature ranges of between 30°C to 45°C, and records fluctuations in body temperature, thereby able to generate data that can create a 'Body Temperature Profile' for the user. This body temperature profile can serve as a baseline for accessing the user's health, a feature which can be crucial during pandemics such as COVID-19 whereby having a record of recent temperature fluctuations of a user, can be used to speed up testing for COVID-19, even more among asymptomatic people. As COVID-19 vaccines are getting approved around the world, the body temperature profile from BiChip V1 can be used to verify the infection status of a user who has not yet received a vaccine, allowing the user to continue with their daily lives where restrictions would have otherwise been imposed for quarantine purposes due to uncertainty about their COVID-19 status. BiChip V1 as an Identity Verifier The Body Temperature Profile generated from the smart thermometer's data can be used as a unique biometric identifier the same way fingerprints are used. In addition to the functionalities the chip provides through its smart thermometer, it also does the prime function of RFID transponders, which is an identification tag that can store a user's data such as their name, date of birth, medical records, etc. This stored data can be used foremost for identity verification, and for access control like opening doors and other activities that require an authentication process.

Fortsættes...


Transponder
Transponder Integrated Circuit
Test Pads
Temperature Sensing
Processing
Memory
Interface

DESCRIPTION OF THE INVENTION

BiChip V1 (version 1) implantable passive RFID-NFC transponder chip with a smart thermometer for health monitoring through in-vivo body temperature monitoring, that can store identification and access control data like opening house and car doors, or checking in at work places, and various forms of contactless payment which require authentication processes.

Physical Components of BiChip V1

All the physical components of the BiChip V1 implantable chip come in a bio-safe bioglass capsule about the size of a grain of rice. The size of the chip makes it possible to easily embed it under the skin using a hypodermic needle.

RFID chips and tags use RFID (Radio-Frequency Identification) technology, which is the wireless identification of objects through radio waves. The physical components of BiChip V1 are a smart thermometer, an integrated circuit, and an antenna. All these components are powered through a magnetic field generated when a reader is brought close to the chip. This magnetic field induces a current in the transponder, powering it and wirelessly transmitting data from it to the RFID reader.

BiChip V1 uses an NFC (Near Field Communication) RFID signal with a frequency of 13.56MHz. This means NFC-enabled smartphones function as the RFID reader of BiChip V1.

The smart thermometer is a temperature sensor integrated into the RFD-NFC transponder. Temperature-dependent characteristics of the p-n junction of the integrated circuit of the RFID-NFC transponder and the temperature sensor, determine the body temperature of the user.

The temperature sensor has first and second bipolar junction transistor portions operating at a constant ratio of emitter current densities. The analog temperature signal corresponds to a difference in base-emitter voltages between these first and second bipolar junction transistor portions.

The integrated circuit of the RFID-NFC transponder and the temperature sensor contain an an analog-to-digital converter, which receives the analog temperature signal and converts it into a digital temperature code that an NFC-enabled smartphone can pick up as data by bringing the smartphone close to where Bichip V1 is implanted on the user's body.

The smart thermometer's temperature sensor can read an analog trim value from the EEPROM read-only memory and adjust the analog temperature signal based on this analog

trim value. The resultant adjustment to the analog temperature signal may be an offset to the analog temperature signal based on the analog trim value, or may be a gain adjustment to an amplification portion of the temperature sensor.

The integrated circuit of the RFID-NFC transponder and the smart thermometer also has a bit-serial adder that can read a fine trim value from the EEPROM read-only memory and then add the digital temperature code to the fine trim value to generate the user's body temperature information. And then both the user's body temperature information and the identification data of the RFID-NFC transponder are transmitted to the reader (smartphone) in a single transmission signal compatible with ISO standards for NFC.

Software Components of BiChip V1

The software components of BiChip V1 are a smartphone app which stores all the data from the chip including the temperature readings and aggregates into a user friendly interface on the smartphone. This smartphone app also serves as a Contact Tracing app, bolstering BiChip V1's overall pandemic monitoring functionalities.

Explanation of Images and Illustrations

IMAGE 1 shows the smart thermometer's temperature sensor system within the transponder-antenna system of BiChip V1.

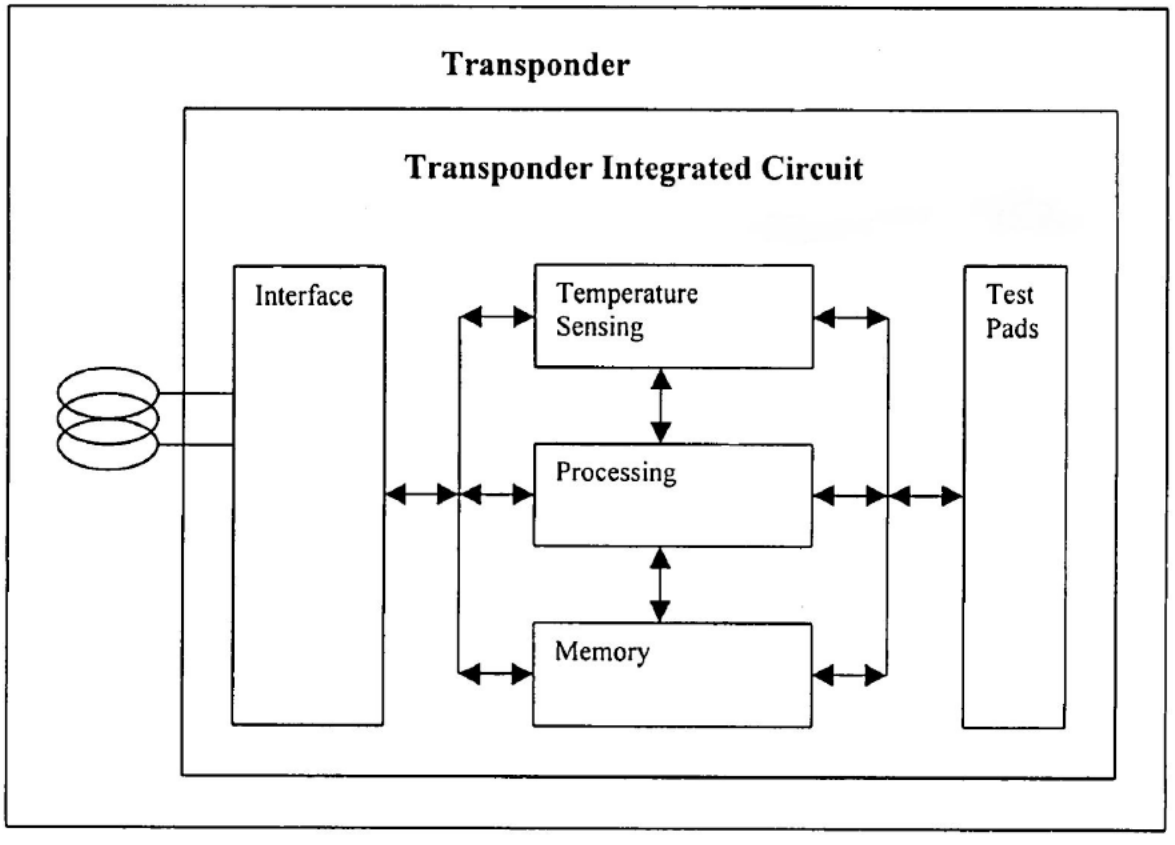


IMAGE 2 shows the major signals communicated between components of the smart thermometer's temperature sensors.

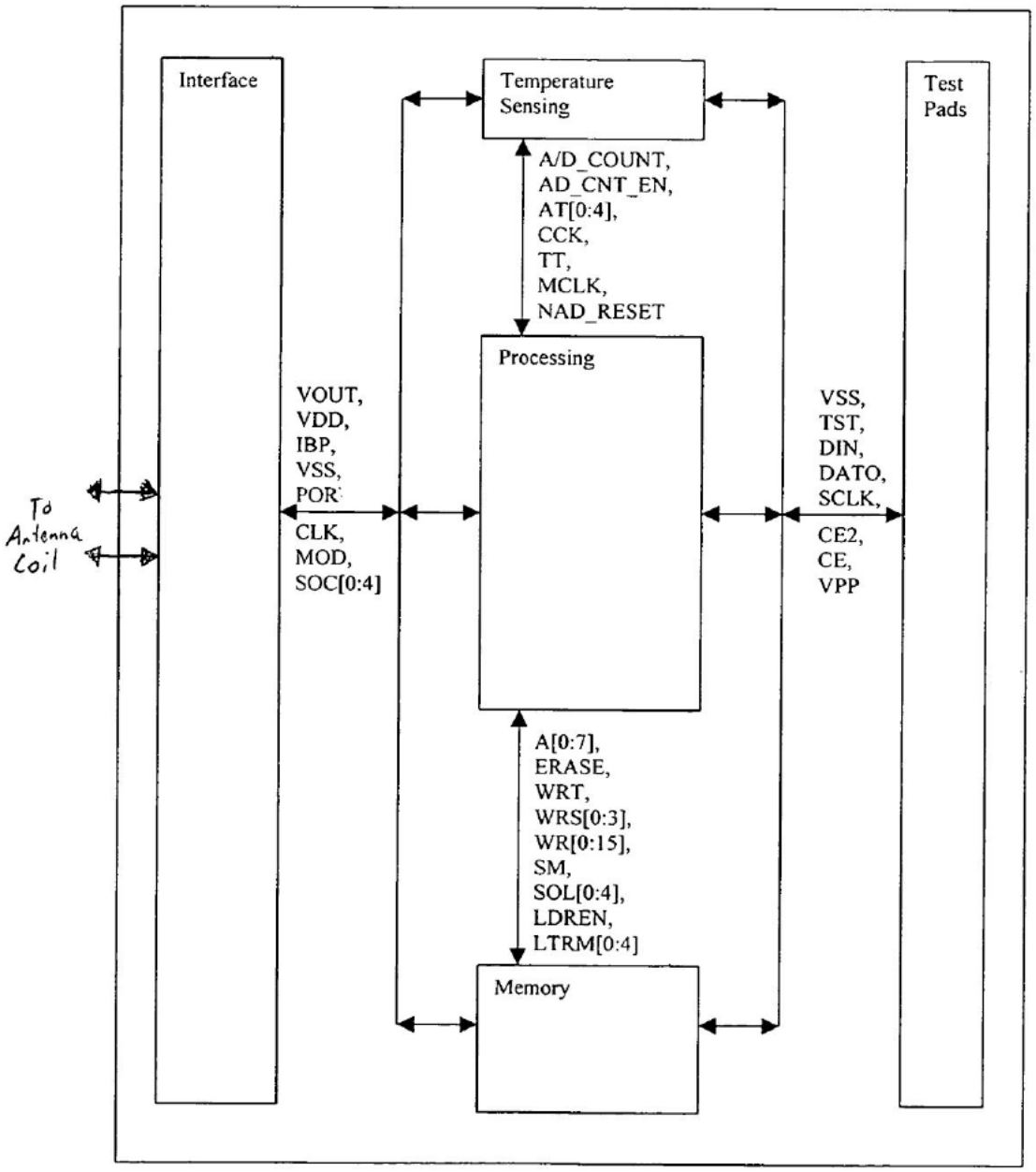


IMAGE 3 shows the temperature sensing circuit.

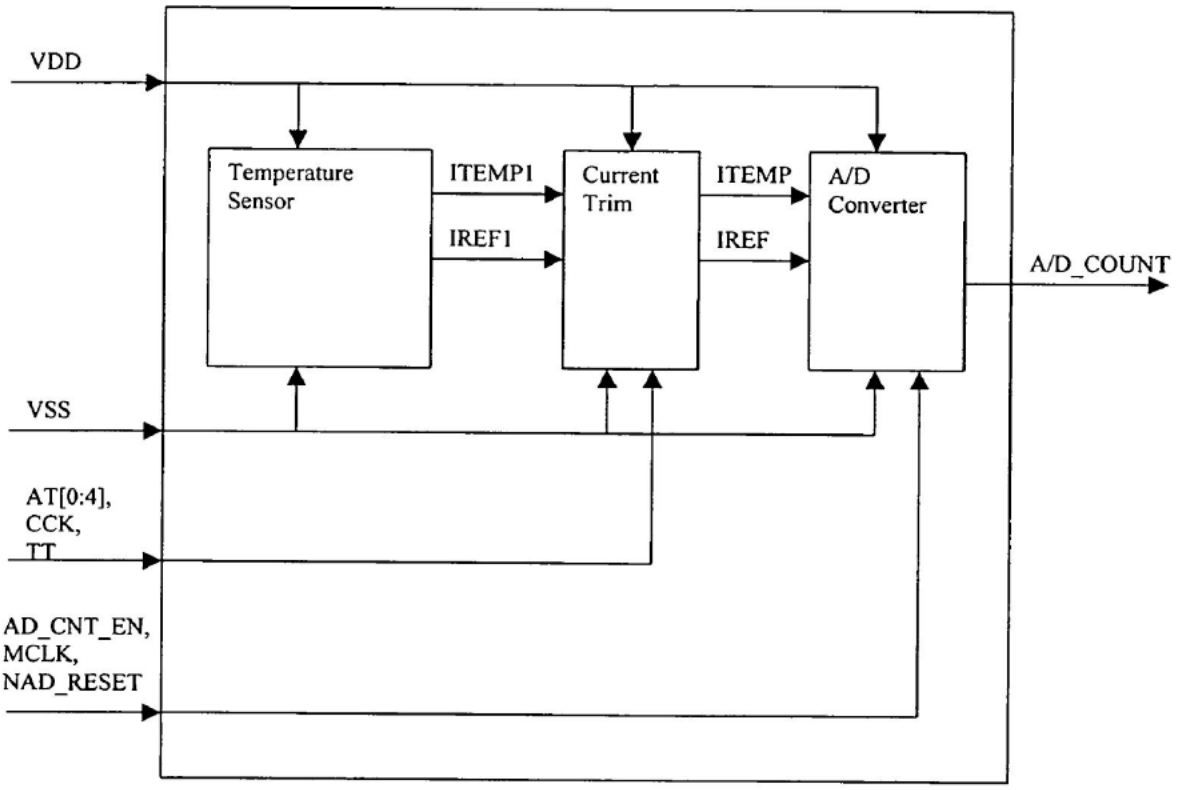


IMAGE 4 is a circuit diagram of the smart thermometer's temperature sensor.

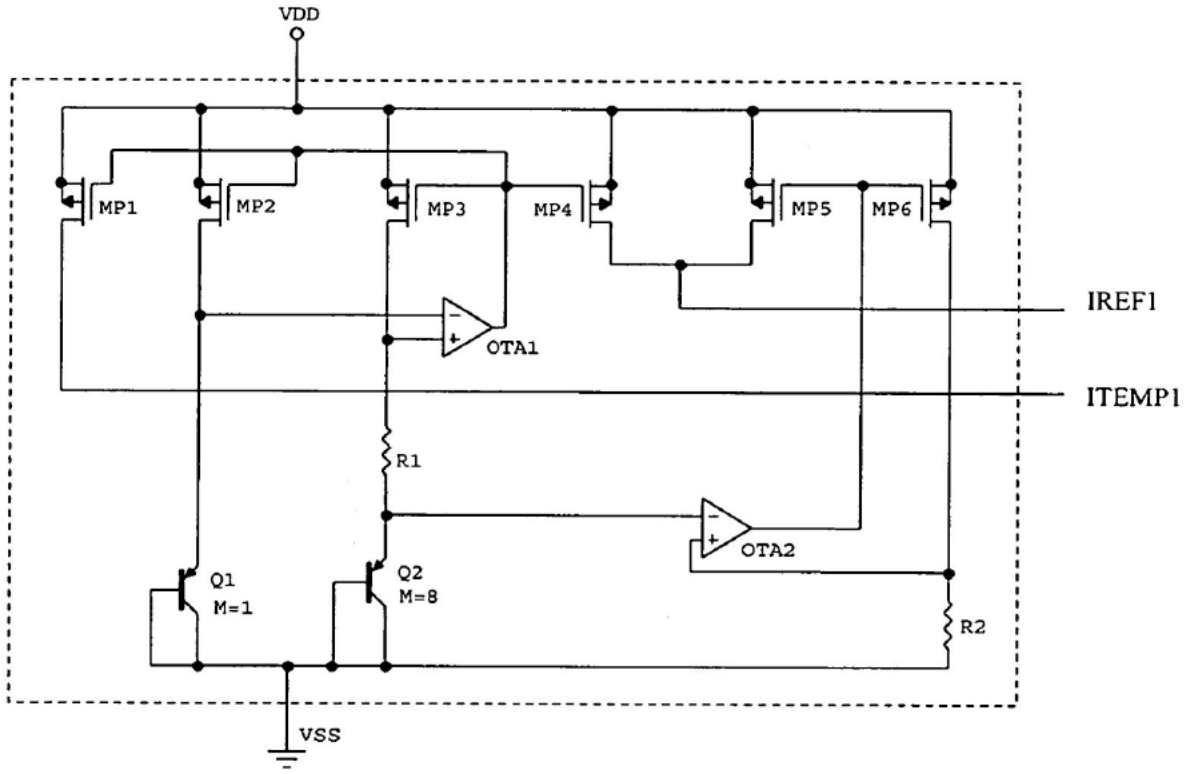
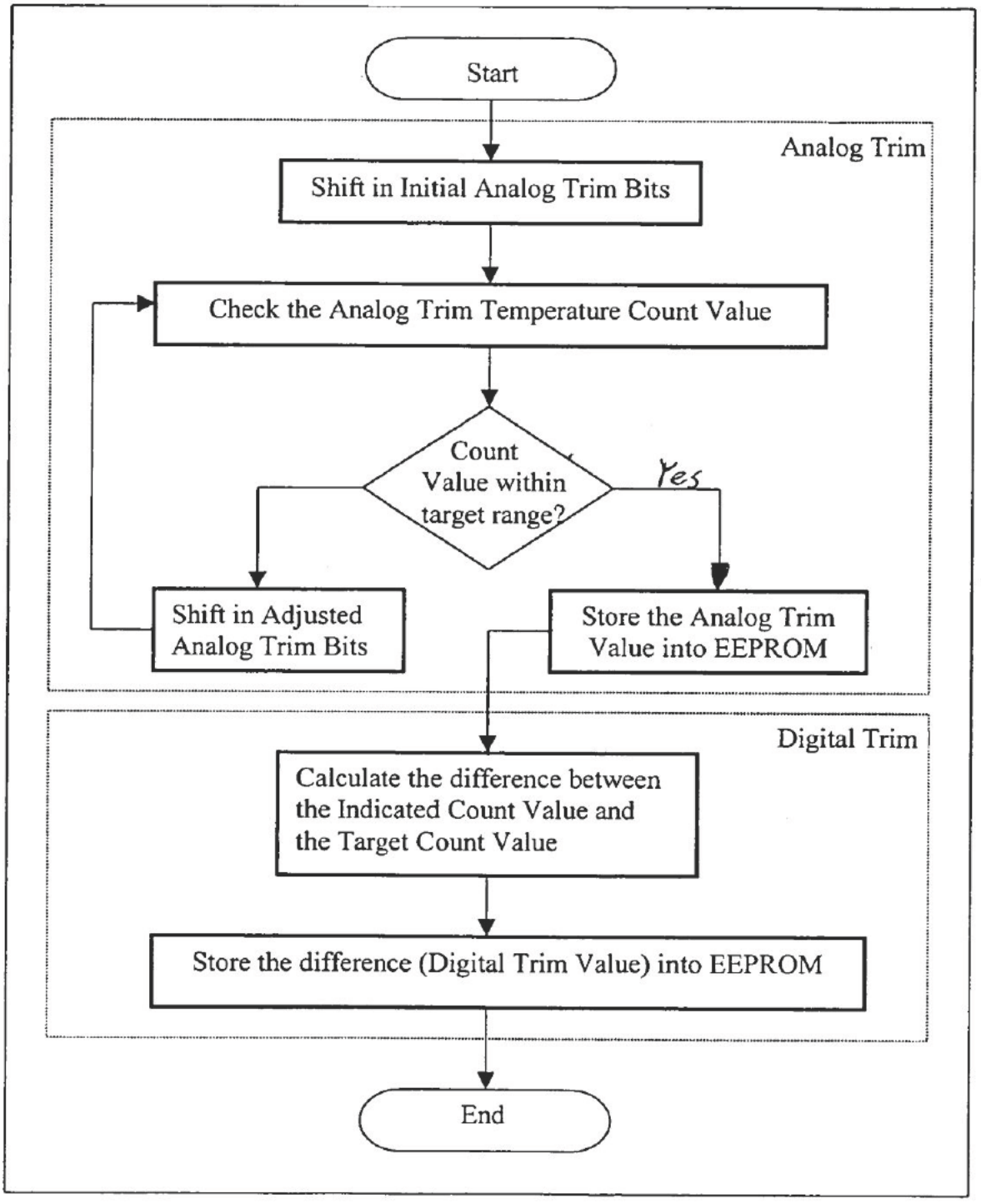


IMAGE 5 shows operational steps for calibrating temperature values of the temperature sensor

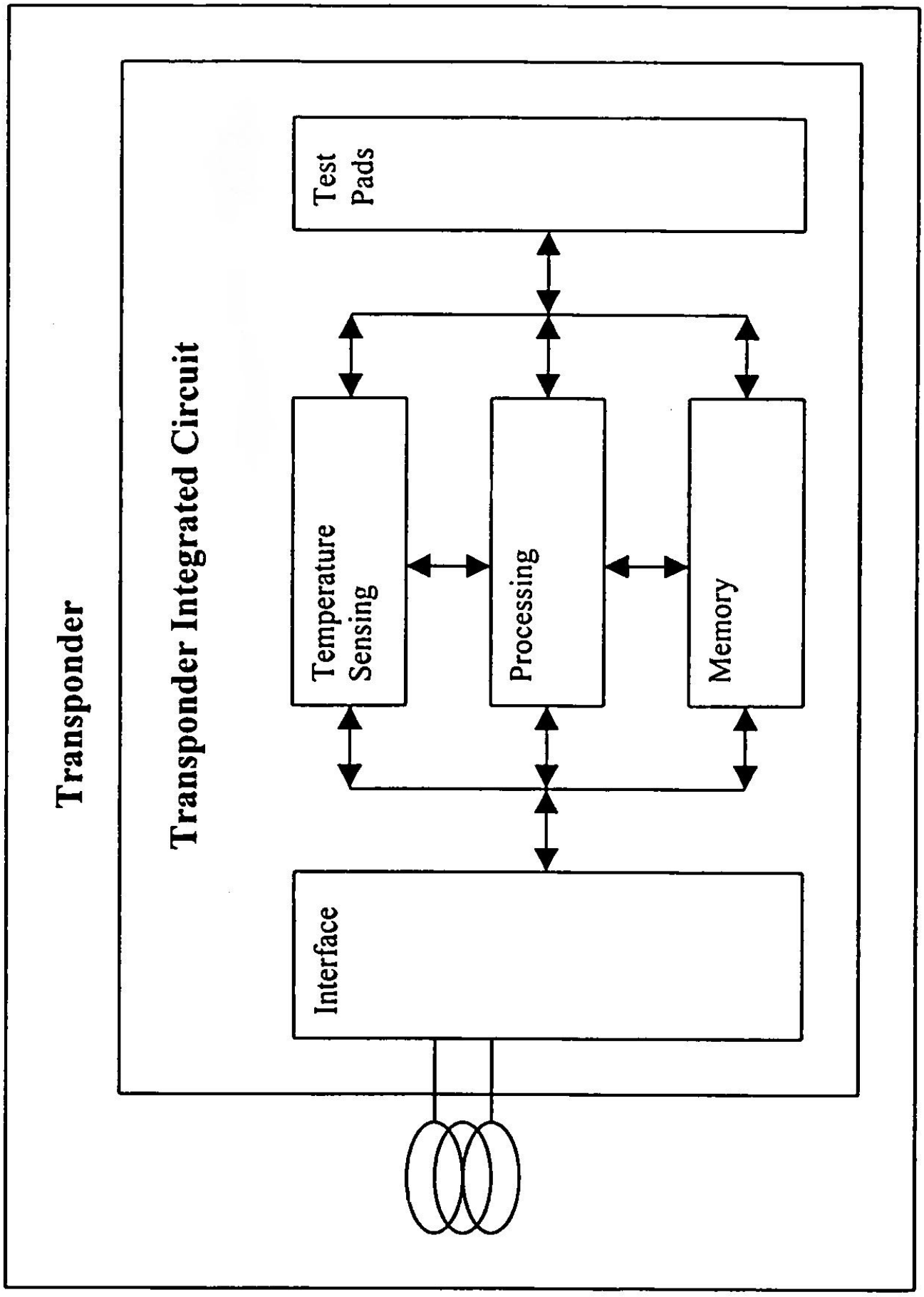


PATENT CLAIMS

Implantable RFID transponders have been used as identification tags for years in mammalian pets like cats and dogs. Their use on humans is also becoming popular among tech enthusiasts who call themselves biohackers, and use them for access control like opening doors or storing passwords and pin numbers. In 2004, the United States Food and Drug Administration approved VeriChip, an implantable RFID transponder which doctors can use to access medical records, demonstrating the viability of implantable RFID transponders.

BiChip V1 is different from all these iterations of implantable RFID transponders because it is the first and only human implantable RFID transponder to incorporate a smart thermometer for the purpose of health monitoring in humans. It is the first implantable RFID transponder whose health monitoring functionalities can be used for health status verification and Contact Tracing efforts during pandemics such as COVID-19.

BiChip V1 is the first implantable RFID transponder that can be used to generate a 'Body Temperature Profile' for a user, which can be used as a unique biometric identifier of the user in the same way fingerprints are used.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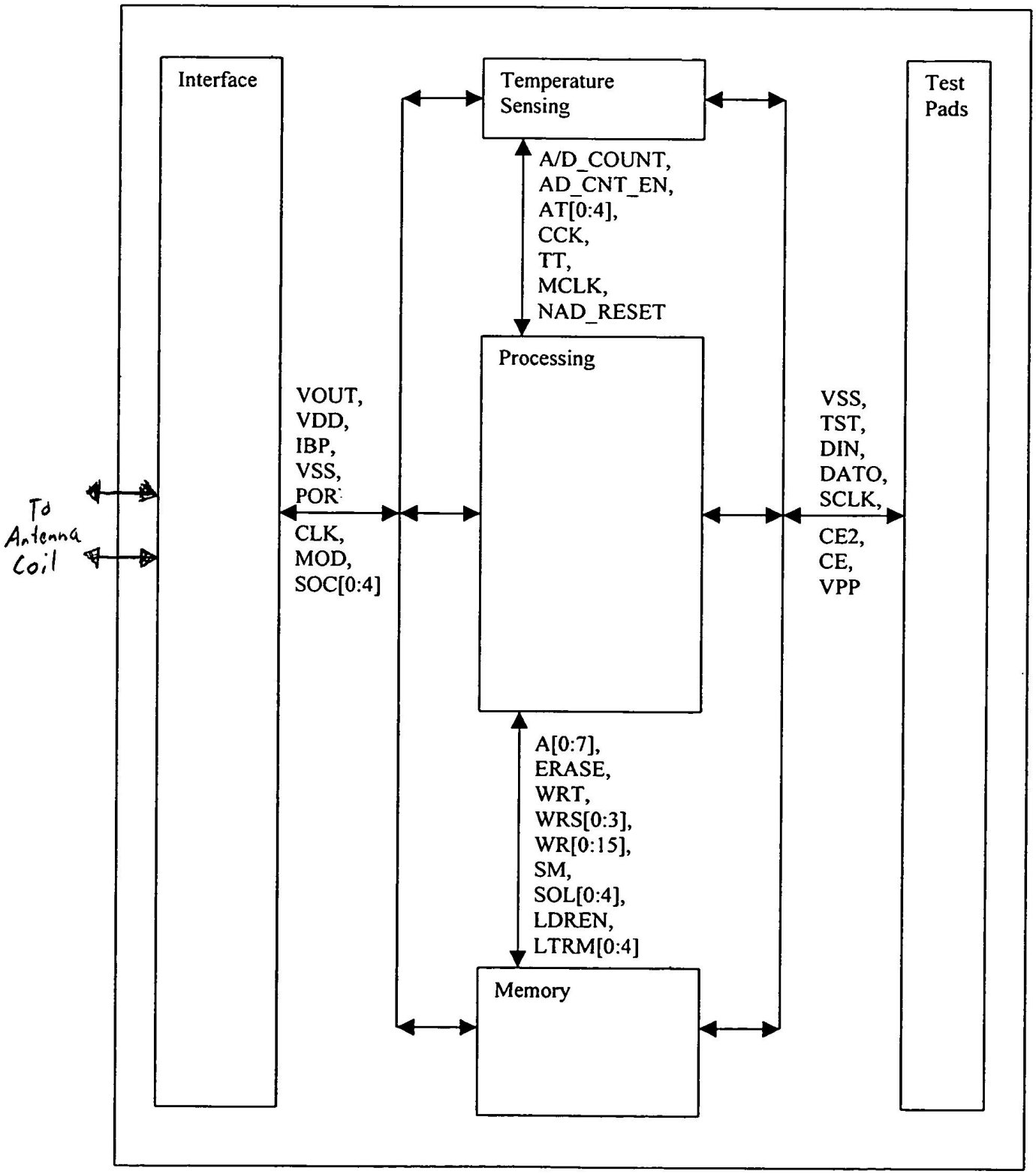
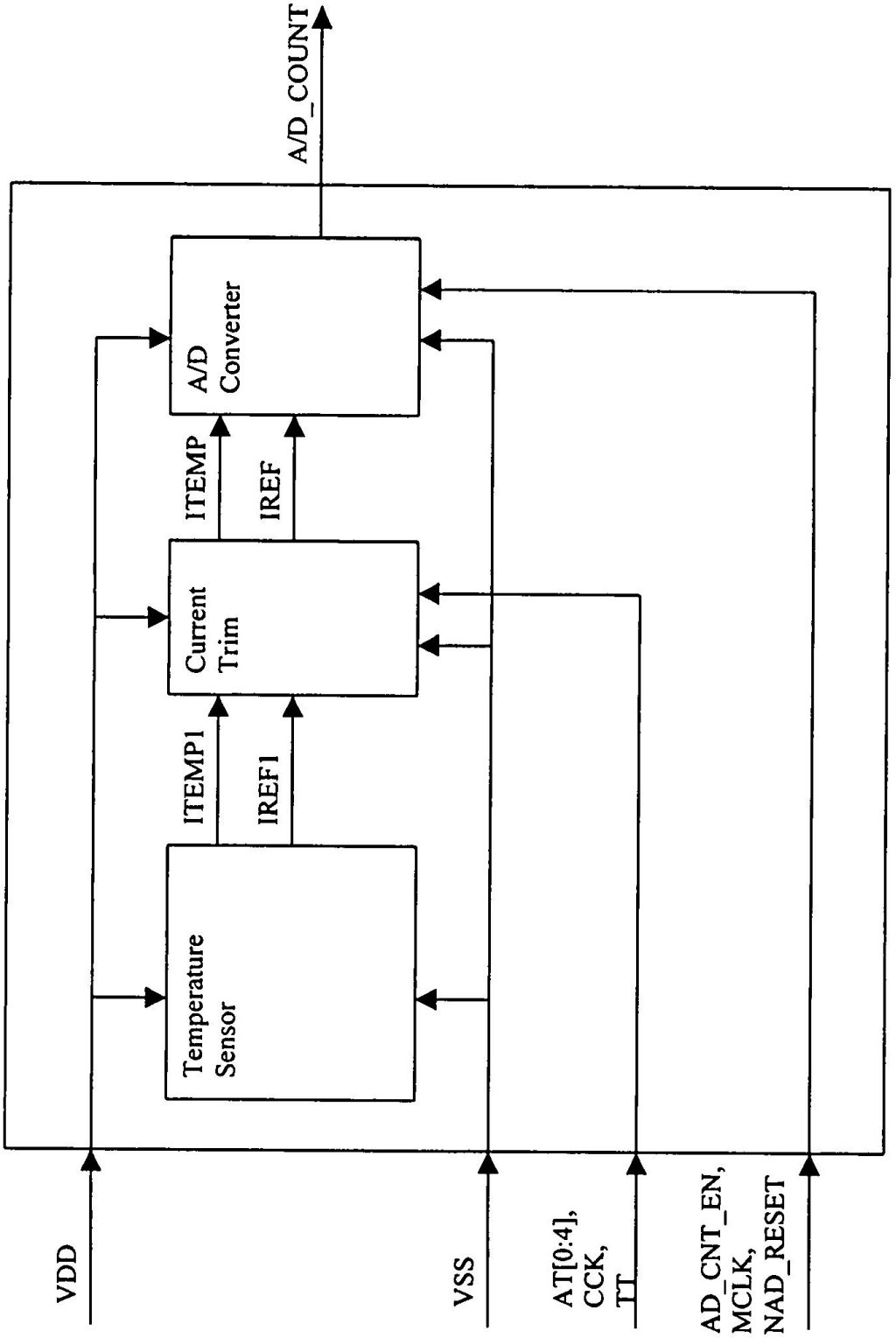
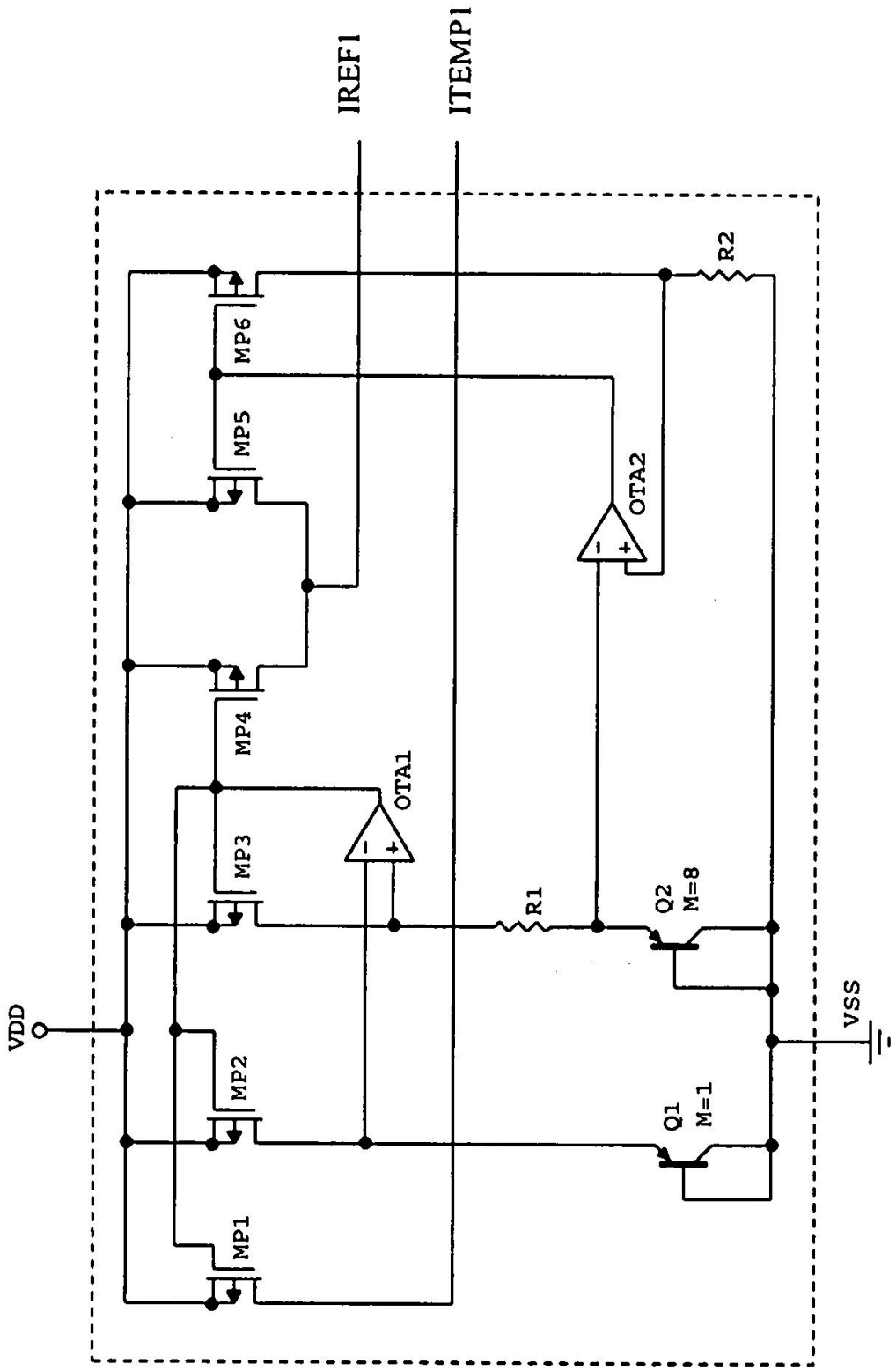
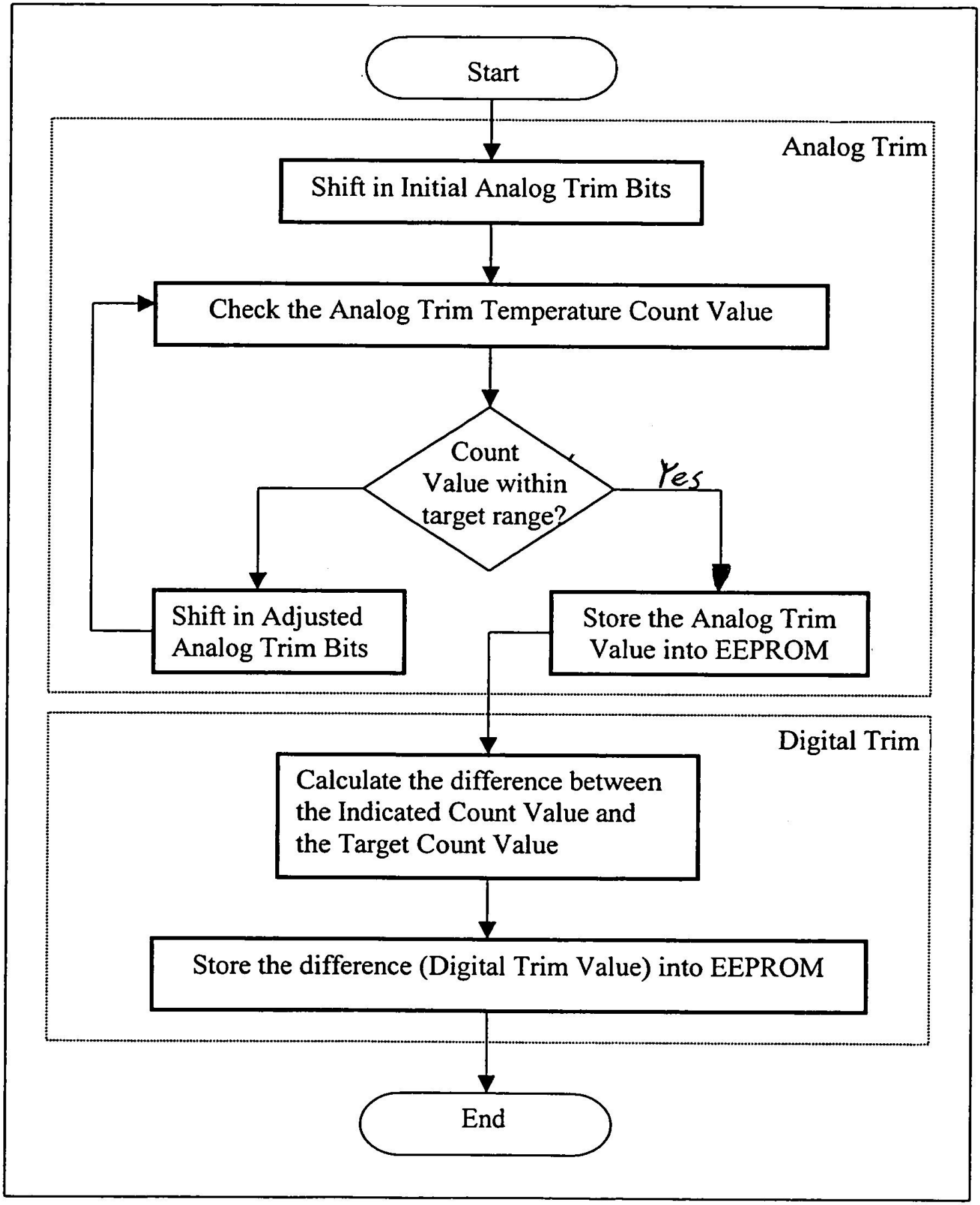

Interface
Temperature Sensing
Test Pads
A/D_COUNT,
AD_CNT_EN,
AT[0:4],
CCK,
TT,
MCLK,
NAD_RESET
Processing
VOUT,
VDD,
IBP,
VSS,
POR
CLK,
MOD,
SOC[0:4]
VSS,
TST,
DIN,
DATO,
SCLK,
CE2,
CE,
VPP
To Antenna Coil
A[0:7],
ERASE,
WRT,
WRS[0:3],
WR[0:15],
SM,
SOL[0:4],
LDREN,
LTRM[0:4]
Memory


A/D_COUNT
A/D Converter
ITEMP
IREF
Current Trim
ITEMP1
IREF1
Temperature Sensor
VDD
VSS
AT[0:4], CCK, TT
AD_CNT_EN, MCLK, NAD_RESET


IREF1
ITEMP1
R2
MP6
MP5
OTA2
MP4
OTA1
MP3
R1
Q2
M=8
VDD
VSS
MP2
Q1
M=1
MP1


Start
Analog Trim
Shift in Initial Analog Trim Bits
Check the Analog Trim Temperature Count Value
Count Value within target range?
Yes
Shift in Adjusted Analog Trim Bits
Store the Analog Trim Value into EEPROM
Digital Trim
Calculate the difference between the Indicated Count Value and the Target Count Value
Store the difference (Digital Trim Value) into EEPROM
End