*TB 9-6695-292-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR FLOW COMPUTER FMSI, MODEL MPC-1000-604R (MIS 38937)

Headquarters, Department of the Army, Washington, DC
18 September 2008

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also send in your comments electronically to our E-mail address: 2028@redstone.army.mil or by fax 256-842-6546/DSN 788-6546. For the World Wide Web use: https://amcom2028.redstone.army.mil. Instructions for sending an electronic 2028 can be found at the back of this manual.

*This bulletin supersedes TB 9-6695-292-35, dated 12 November 1992.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Flow Computer, FMSI, Model MPC-1000-604R (MIS 38937). The manufacturer's manual was used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. None

b. Time and Technique. The time required for this calibration is approximately 4 hours, using the dc and low frequency technique.

2. Forms, Records, and Reports

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported are designated (R) at the end of the sentence in which they appear. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
RTD calibration	50° F to 150° F ±0.2° F
CF input calibration	10.5 V p-p approximately 50 kHz
1 MHz clock calibration	1.0 MHz ±50 ppm

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standards Set AN/GSM-286, AN/GSM-287 or AN/GSM-705. Alternate items may be used by the calibrating activity. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

5. Accessories Required. The accessories required for this calibration are common usage accessories issued as indicated in paragraph **4** above and are not listed in this calibration procedure.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
COOL/HEAT SOURCE	Temperature range: 40° F to 160° F	Thermalcal Inc., Model M28
FREQUENCY COUNTER	Frequency range: Dc to 1 MHz Accuracy: ±50 ppm	Fluke, Model PM6681/656 (PM6681/656)
MULTIMETER	Voltage range: 0 to +5.00 V dc Accuracy: ±001 V dc	Hewlett Packard, Model 3458A (3458A)
OSCILLOSCOPE	Frequency range: Dc to 50 kHz Voltage Range: 10 V p-p Accuracy: ±3%	Agilent, OS-303/G (OS-303/G)
THERMOMETER	Temperature range: 40° F to 160° F Accuracy: ±0.05° F	Azonix, Model A1012 (MIS 38958) w/Temperature Probe Instrulab, Model 4101-10X

SECTION III
CALIBRATION PROCESS

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

c. Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in the procedure. Additional maintenance information is contained in the manufacturer's manual for this TI.

d. Unless otherwise specified all controls and control settings refer to the TI.

7. Equipment Setup

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Connect 115 V ac power source to 120 VAC POWER INPUT (fig. 1).

b. Connect the resistance temperature device (RTD) to the RTD INPUT connector (fig. 1).

c. Connect cool/heat source and thermometer to ac power source. Set power to cool/heat source and thermometer to on and allow cool/heat source 30 minutes stabilization period.

d. Insert the TI RTD probe and thermometer probe into the cool/heat source.

e. Press **POWER** switch on front panel. System performs an internal self-test. If system is set for a cold start, it will then display **COLD** followed by the downloading of special function coefficients from the EPROM to the NVRAM. Finally, system will enter the mode selected by front panel rotary switch and begin operation.

f. Set rotary switch on front panel to 1.

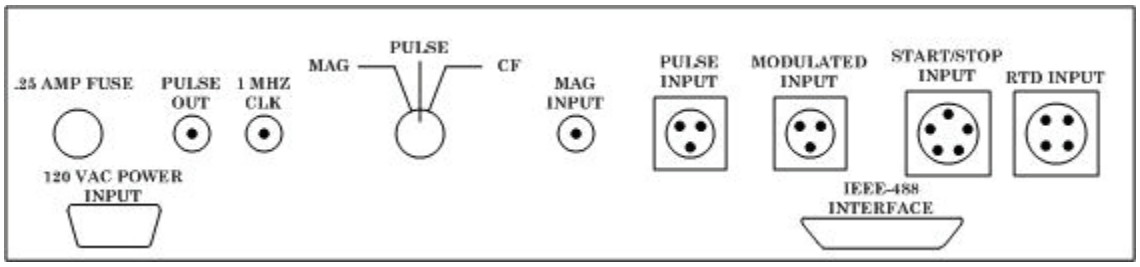

Figure 1. Back panel.

8. RTD Calibration

a. Performance Check

NOTE

The RTD temperature sensor in the model MPC-1000-604R may be calibrated by either software or hardware. The computer utilizes a multi-order polynomial equation to define the temperature curve. The equation is as follows:

$-RT = K0 + K1(x) + K2(x^2) + K3(x^3)$

-RT = Resistance temperature

-K0-K3 = A set of temperature coefficients determined by calibration of a specific RTD.

NOTE

When the RTD characteristics have not changed, then the calibration is to correct for long-term drift usually effecting the zero offset, perform **a** (1) through (6) below.

NOTE

If the type of RTD is changed, then a new polynomial must be fit to it. In order to calibrate the RTD it is necessary to develop the relationship between temperature and the output from the A to D converter circuit. Looking at the equation, if K0, K2, and K3 become zero and K1 becomes 1, then RT = x. This means the display shows the digital output from the converter; pressing **f(x) 273** keys sets the order of the temperature polynomial. Setting this to 1 causes the computer to only look at the K0 and K1 terms. Perform **a** (1) and (2) then (7) through (12) below.

(1) Connect multimeter positive lead to pin 36 of U42 and negative lead to pin 39 of U42. If multimeter does not indicate between +1.249 and +1.251 V dc, perform **b** (1) below.

(2) Disconnect multimeter from TI.

(3) Adjust cool/heat source to between 45° F and 55° F and allow TI to stabilize. Press special function **f(x), 1,** and **ENTER** keys to display the temperature. If display indication is not within ±0.2° F of thermometer readout, perform **b** (2) below.

(4) Adjust cool/heat source to between 145° F and 155° F and allow TI to stabilize. If display indication is not within ±0.2° F of thermometer readout, perform **b** (3) below.

(5) Repeat (3) and (4) above until no further adjustments are required.

(6) Adjust cool/heat source to between 80° F and 90° F and verify the calibration.

(7) To set the computer for this calibration, press **f(x), 2, 6, 9,** and **ENTER** keys. At the prompt, press the **0** key. For special functions 270 and 273, press **f(x), 2, 7, 0**, **ENTER** and **2, 7, 3,** and **ENTER** keys, and at the prompt for each special function, press the **1** key.

(8) Set the TI RTD in cool/heat source stabilized at 50° F and read the A to D reading being displayed when **f(x) 1** key is pressed.

(9) Take incremental readings at each 10° F between 50° F and 150° F. Record both the temperature and the displayed A to D value.

(10) Using a curve fitting routine, fit the temperature and the A to D data to a curve and determine its coefficients.

(11) Enter these coefficients into special functions 269 through 272 by pressing **f(x)** key to precede each special function number (i.e., **2, 6, 9),** press **ENTER** and at the prompt the coefficient.

(12) After pressing **f(x), 2, 7, 3,** and **ENTER** keys, enter the polynomial in special function f(x) 273.

b. Adjustments

(1) Adjust reference potentiometer VR5 on the 604R application board for a multimeter indication of 1.250 (R).

(2) Adjust zero potentiometer VR6 on the 604R application board for a display reading corresponding to the thermometer readout (R).

(3) Adjust span VR7 on the 604R application board for a display reading corresponding to thermometer readout (R).

9. CF Input Calibration

a. Performance Check

(1) Attach the output from a CF pickoff (mounted on a flow meter) to the MODULATED INPUT (fig. 1) on the rear panel using the 150 foot cable.

(2) Set the back panel selector to the CF position (fig. 1).

(3) Connect oscilloscope to the flow meter interface board with the ground attached to J4.2 and the signal input to J4.1. Set oscilloscope to measure 10 V p-p at approximately 50 kHz.

(4) Oscilloscope will indicate between 10.0 and 11.0 V p-p and a frequency of approximately 50 kHz; if not, perform **b** below.

(5) Disconnect oscilloscope from TI.

b. Adjustments. Adjust VR3 for a 10.5 V p-p indication on oscilloscope (R).

10. 1 MHz Clock Calibration

a. Performance Check

(1) Connect frequency counter to 1 MHZ CLK connector (fig. 1) on rear panel. Frequency counter will indicate 1 MHz ±50 ppm; if not, perform **b** below.

(2) Disconnect frequency counter from TI.

b. Adjustments. No adjustments can be made; replace the clock.

11. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

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0820606

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344481, requirements for calibration procedure TB 9-6695-292-24.

Instructions for Submitting an Electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" whomever@redstone.army.mil
To: <2028@redstone.army.mil

Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT –93
8. **Pub no:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**

This is the text for the problem below line 27.