1. DESCRIPTION.

The FT193 Transmitter utilizes a chopper wheel and photo pickup to provide both a 4-20 mA DC current signal and a scaled pulse output directly proportional to flow rate to operate remotely located indicators, totalizers, recorders and controllers. In addition, the 193 provides a 6 digit direct reading flow totalizer that operates independent of the electrical signal outputs.

Basic scaling is done by the selection of gears. Contact the factory for assistance.

2. DISASSEMBLY AND REMOVAL OF TRANSMITTER MECHANISM

a. Remove the six bonnet screws (1) securing bonnet assembly (2) to mounting base (21). Remove bonnet assembly. To troubleshoot electronics no further disassembly is required.

b. Remove three mechanism mounting screws (3) and washers (4) securing mechanism to mounting base (21). Lift out mechanism.

c. Dissemble transmitter mechanism as required in accordance with Figure 1.

3. TEST AND CALIBRATION

3.1 Equipment Required:

Sparling Model 702 Pulse Calibrator
3 1/2 digit digital ammeter
Adaptor plug (optional) or jumper with alligator clips.
DC voltage supply between 18 and 30 volts (for bench testing)
3.2 Preliminary Calculations

3.2.1 If the meter record or meter I.D. label states the (whole) number of Hertz (PPS) to produce calibration current in the range of 19-22 mA, proceed directly to step 3.3.

3.2.2 If the meter record states full scale input frequency, F, (e.g., 23.2 Hz) at 20 mA output, calculate calibrator values as follows:

3.2.2(a) Round off the full scale frequency to the nearest integer to obtain F cal, (e.g., F = 23.2 Hz, F_cal = 23 Hz.)

3.3.3 (b) Calculate Fcal produced when 702 calibrator is set to F_cal:

\[ I_{cal} = \left(16 \times F_{cal}\right)/F + 4 \text{ mA} \]

\[ I_{cal} = \left(16 \times 23\right)/23.2 + 4 \text{ mA} \]

\[ = 19.862 \text{ mA} \]

3.2.2(c) (Optional) Calculate T = time between totalizer clicks while on 702 calibrator:

\[ T = \left(60 \times R_x F\right) / \left(Q \times F_{cal}\right) \text{ in seconds} \]

where:

- \( R \) = Output registration (Gal/pulse)
- \( Q = \text{FS flow rate (GPM)} \)
- \( F_{cal} = \text{Calibrator frequency (Step 3.2.2(a))} \)

\[ R = 100 \text{ Gal/Pulse; } Q = 600 \text{ GPM; } F_{cal} = 23.2 \text{ Hz} \]

\[ T = \left(60 \times 100 \times 23.2\right) / \left(600 \times 23\right) \]

\[ = 10.1 \text{ sec/pulse} \]

3.3 CALIBRATION OF 4-20 mA OUTPUT

4 to 20 mA TB3

![Diagram of 4 to 20 mA Output]

*Requires the 4 to 20 mA Output to be powered for the scaled Electronic Pulse Output to function.

3.3.1 For bench testing, remove pcb from meter and power up 4-20 mA loop (TB3 on PCB) with external DC power supply in series with current DVM.

3.3.2 For field testing, remove meter bonnet and insert DVM in 4-20 mA loop (violet and blue wires). Unplug chopper wheel harness plug at four-position TB1 on the PCB by gently rocking the plug (avoid excessive force).

3.3.3 Install polarized adapter plug in TB1 or jumper together pins 1 and 2 of TB1 (pin 1 is topmost, nearest pot R1).

3.3.4 Connect 702 calibrator as follows:

- 9 V PULSE to TB1, pin 3 (or test point TB2)
- "GROUND" to TB1, pin 4 (or test point TP1)

3.3.5 With calibrator "OFF", verify DVM reading of 4.00 mA ±0.02 mA. Adjust "OFFSET" pot R1 (just above TB1) if necessary.

3.3.6 Set calibrator to F_cal (see step 3.2.2 or 3.2.2.2(a)) and turn switch to "ON". After current stabilizes (typically 2-3 minutes), verify that DVM reads I_cal ±0.02 mA. If necessary, make small adjustments to "SPAN" pot R12 (just below TB1) waiting each time for current to stabilize.

3.3.7 Repeat steps 3.3.5 and 3.3.6 as necessary.

3.4 VERIFICATION OF PULSE OUTPUT SCALING (OPTIONAL)

3.4.1 Perform steps 3.2.2(c) and 3.3.1 through 3.3.4. (See wiring diagram figure 2 for wiring detail of output if bench testing).

3.4.2 Set calibrator to F_cal and turn to "ON". Use watch to verify time between counts as calculated in step 3.2.2(c). For greater accuracy, measure time between 10 counts (e.g., 9.9 sec between counts or 99 sec between 10 counts).

4. RESCALING

The current output may be rescaled by adjusting the span pot if the new full scale flow rate is still within the accuracy limits of the meterhead and the pulse registration is not changed. Changing pulse registration requires change of gears. Contact the factory for assistance.

4.1 Obtain from the meter record the old f.s. input frequency, \( F_{old} \) (Hz) for the original flow rate, \( Q_{old} \) (GPM).

4.2 Calculate \( F_{new} \) for the desired flow rate, \( Q_{new} \) (GPM).

\[ F_{new} = F_{old} \times Q_{new} / Q_{old} \]

\[ F_{new} = 23.2 \text{ Hz; } Q_{old} = 600 \text{ GPM; } Q_{new} = 1000 \text{ GPM} \]

\[ F_{new} = 23.2 \times 1000/600 = 38.667 \text{ Hz} \]

4.3 Use this value \( F_{new} \) in place of \( F \) and perform steps 3.2.2(a), and (c) to obtain F_cal, I_cal and T values.

4.4 Follow procedure in 3.3 and 3.4 to complete rescaling. Mark the meter record and its label accordingly.

5. TROUBLESHOOTING

Follow the troubleshooting chart figure 4. When replacing the pcb, make sure the new pcb is scaled the same way (see section 3). In particular, verify that end mounted diodes CR5,6, and 7 are programmed by cuts the same way as on the old pcb (refer to schematic, 531328 Table 1 for programming pulse output divider section of pcb).

6. ASSEMBLY AND INSTALLATION

a. After assembling the transmitter mechanism, pivot the frame and chopper wheel assembly (12) to bring switch "B" gear (14) into mesh with switch "A" gear (13). Check vertical alignment of gears. Make certain that the gears are not in contact merely at the tips of the teeth, nor too tightly meshed. Spin the gears to check for possible binding.

b. Secure the mechanism to base (21) with three mounting screws (3) and washers (4), making sure that "B" change gear (20) meshes with "A" change gear (19) prior to tightening the screws.

c. A small amount of backlash should exist between the meter drive gear and the driven gear. Recheck backlash in several positions of rotation.

d. Install gasket (16), spacer assembly (22) and bonnet (2). Secure bonnet to mounting base (21) with six screws (1).
<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No outputs (not even 4mA output and no pulse output)</td>
<td>No power to meterhead.</td>
<td>Disconnect violet and blue output leads from external wires. Measure voltage across external wires. It should be between 18 and 30 Vdc. Provide proper power.</td>
</tr>
<tr>
<td></td>
<td>Power supply leads reversed.</td>
<td>Replace printed circuit board.</td>
</tr>
<tr>
<td></td>
<td>Printed circuit board failure.</td>
<td></td>
</tr>
<tr>
<td>2. 4-20mA output is fixed at some value higher than 5mA regardless of flowing condition. May be &gt; 20mA</td>
<td>External power supply too large.</td>
<td>Disconnect blue and violet output leads from external wires. Measure voltage across external wires. Voltage should be between 18 and 30 Vdc. Provide proper power.</td>
</tr>
<tr>
<td></td>
<td>Output leads reversed.</td>
<td>Check to insure (+) terminal of external power supply is connected to violet output lead.</td>
</tr>
<tr>
<td></td>
<td>Printed circuit board failure.</td>
<td>Replace printed circuit board.</td>
</tr>
<tr>
<td>3. 4-20mA output responds to flow, but pulse output does not respond</td>
<td>Pulse output leads not properly wired.</td>
<td>Insure pulse output leads are properly connected with correct polarity (Hi-orange Lo-Brown) and have continuity to output device and external power.</td>
</tr>
<tr>
<td></td>
<td>Printed circuit board failures.</td>
<td>Replace printed circuit board.</td>
</tr>
<tr>
<td>4. Pulse output responds to flow but 4-20mA output does not respond</td>
<td>4-20mA leads not properly wired.</td>
<td>Insure 4-20mA output leads are properly connected with correct polarity and have continuity to output device and external power.</td>
</tr>
<tr>
<td></td>
<td>Printed circuit board failure.</td>
<td>Replace printed circuit board.</td>
</tr>
<tr>
<td>5. 4-20mA output is fixed near 4mA and no output pulses occur under flowing conditions. (Meter does not respond to flow)</td>
<td>Flow is below the range of the meterhead.</td>
<td>Increase flow rate to get output.</td>
</tr>
<tr>
<td></td>
<td>Printed circuit board failure.</td>
<td>Replace printed circuit board.</td>
</tr>
<tr>
<td>6. Both outputs function but respond to flow inaccurately</td>
<td>Not properly calibrated.</td>
<td>Follow Section 3 (Test and Calibration).</td>
</tr>
<tr>
<td></td>
<td>Printed circuit board failure.</td>
<td>Replace printed circuit board.</td>
</tr>
</tbody>
</table>

*Figure 4.*
<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Screw, Bonnet Mounting</td>
<td>121632</td>
</tr>
<tr>
<td>2</td>
<td>Bonnet Assy</td>
<td>524183</td>
</tr>
<tr>
<td>3</td>
<td>Screw, Mechanism Mounting</td>
<td>108218</td>
</tr>
<tr>
<td>4</td>
<td>Washer, Mechanism Mounting</td>
<td>134239</td>
</tr>
<tr>
<td>5</td>
<td>Screw</td>
<td>107913</td>
</tr>
<tr>
<td>6</td>
<td>Washer</td>
<td>101551</td>
</tr>
<tr>
<td>7</td>
<td>Dial, Register</td>
<td>512881</td>
</tr>
<tr>
<td>8</td>
<td>Plate, Backing Dial</td>
<td>516437</td>
</tr>
<tr>
<td>9</td>
<td>Register Clock Assy (1:1 Ratio)</td>
<td>512443</td>
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<tr>
<td>9</td>
<td>Register Clock Assy (5:1 Ratio)</td>
<td>516271</td>
</tr>
<tr>
<td>9</td>
<td>Register Clock Assy (10:1 Ratio)</td>
<td>528515</td>
</tr>
<tr>
<td>10</td>
<td>P.C. Board Assy</td>
<td>531328</td>
</tr>
<tr>
<td>11</td>
<td>Cable Assy</td>
<td>510603</td>
</tr>
<tr>
<td>12</td>
<td>Frame &amp; Chopper Wheel Assy</td>
<td>540973</td>
</tr>
<tr>
<td>13</td>
<td>&quot;A&quot; Switch Gear Assy (Specify Number of Teeth)</td>
<td>118069</td>
</tr>
<tr>
<td>14</td>
<td>&quot;B&quot; Switch Gear Assy (Specify Number of Teeth)</td>
<td>130013</td>
</tr>
<tr>
<td>15</td>
<td>Seal, O-Ring</td>
<td>100660</td>
</tr>
<tr>
<td>16</td>
<td>Seal, Flat Gasket</td>
<td>138299</td>
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<tr>
<td>17</td>
<td>Standoff</td>
<td>531245</td>
</tr>
<tr>
<td>18</td>
<td>Shaft Assy, Main Drive</td>
<td>509838</td>
</tr>
<tr>
<td>19</td>
<td>&quot;A&quot; Change Gear Assy 5 thru 16 Teeth</td>
<td>131110</td>
</tr>
<tr>
<td>19</td>
<td>&quot;A&quot; Change Gear Assy 17 - 45 Teeth</td>
<td>117342</td>
</tr>
<tr>
<td>20</td>
<td>&quot;B&quot; Change Gear Assy @ least 14 Teeth</td>
<td>118069</td>
</tr>
<tr>
<td>21</td>
<td>Base, Mounting</td>
<td>531196</td>
</tr>
<tr>
<td>22</td>
<td>Spacer Assy</td>
<td>509846</td>
</tr>
<tr>
<td>23</td>
<td>Shaft, Extension</td>
<td>509812</td>
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<tr>
<td>24</td>
<td>Photocoupler &amp; Cable Assy</td>
<td>531253</td>
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<tr>
<td>25</td>
<td>Screw, Transmitter Mounting</td>
<td>101238</td>
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<tr>
<td>26</td>
<td>Clevis Male</td>
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<tr>
<td>27</td>
<td>Clevis Female</td>
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<tr>
<td>28</td>
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<td>29</td>
<td>Glass</td>
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<td>30</td>
<td>O-Ring Glass Seal</td>
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<tr>
<td>31</td>
<td>Gasket</td>
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