Technical Bulletin, Communicating with Auto-Adjust Turbo Meter Gas Flowmeters

OMNI FLOW COMPUTERS, INC.
12620 West Airport Boulevard, Suite 100
Sugar Land, Texas 77478 United States of America
Phone-281.240.6161 Fax: 281.240.6162
www.omniflow.com

52-0003-0005/Rev B

NOTE: User Manual Reference - This Technical Bulletin complements the information contained in the User Manual applicable to Revision 23.74/27.74+.

Table of Contents

Figures

Scope

This Technical Bulletin applies to firmware revisions 23.74+ and 27.74+ of OMNI 6000/OMNI 3000 Flow Computers, for gas flow metering systems.

Abstract

The Auto-Adjust (AAT) Turbo-Meter (Figure 1) generates a self-checking output that is derived from the ratio between the main and sensing rotor pulses. This output is referred to as Delta A. The self-checking feature indicates how much adjustment the meter is making, thereby warning the user of meter or flow-conditioning problems. The OMNI Flow Computer totalizes the flowmeter pulse input signal received from the Auto-Adjust Turbo-Meter.

AAT Flowmeter Theory of Operation

The Auto-Adjust (AAT) Turbo-Meter was introduced in the early 1980's. This meter has larger bearings, rugged rotor shafts, and unique dual rotor, is similar to that for a single rotor turbine. However, the second rotor, or sensing rotor, is unique in that its speed reacts to changes that occur to the main rotor. The pulse signals from the two (2) rotors are fed into the flow computer where algorithms calculate an adjusted volume and a self-checking value called "Delta-A". The adjusted volume is based on original factory calibration accuracy and gives the ATT the ability to compensate for a number of conditions that could degrade the accuracy of a single rotor turbine meter. While the meter is operating, the Delta-A output detects shifts in accuracy that could go unnoticed in a single rotor turbine meter. The periodic Delta-A reading indicates that a shift in accuracy did occur.

OMNI Flow Computer Logic

NOTE: Gross Flow Rate Equation - Qv=(Pm/Km)-(Ps/Ks) *3600
Adjusted Volume Equation – (Pm/Km) – (Ps/Ks) *Time
Pm: Main Rotor Pulses
Ps: Sensing Rotor Pulses
Km: Main Rotor Pulse Factor
Ks: Sensing Rotor Pulse Factor

The OMNI Flow Computer determines the actual flow rate from the live pulse frequency signal inputs, which has been assigned and configured. This calculation is done every 500 milliseconds using pulses read from the Main and Sensing rotors of an Auto-Adjust Turbo-Meter. By combining these pulses along with the unique pulse factors for each rotor in an adjusted volume (Cumulative Gross) equation, a gas measurement volume will be calculated. In addition to the adjusted volume equation, algorithms are included that provide corrections to the volume totalization for conditions of Leakage flow, Resonant No-Net flow, Severe flow pulsation or Non-Steady flow.

- **Self-Checking (Delta-A) Calculation -** This calculation is performed after 25,000 main rotor counts are accumulated or after a time interval of 512 seconds has elapsed, whichever occurs first. The equation for this calculation compares the speed ratio of the Main rotor and Sensing rotor with the average speed ratio determined at factory calibration. The average factory value is represented by the "A-bar" value in percent. The calculation difference in field operation from the A-bar value is the % Deviation or Delta-A reading.
- **Warning Flags and Alarm Outputs -** The logic and algorithms in this section compare error conditions and Delta-A values to limits that are fixed or operator selected. Warning flags, alarms, and messages are set depending upon which limits are exceeded.
- **Un-Adjusted Volume Calculation -** This section shows how the mechanical or Un-Adjusted volume is properly calculated using the pulses from the Main rotor only. This volume is to be used in the measurement totalization when pulses from the Sensing rotor are unavailable or when the gas flow rate is below the minimum for the Adjusted output.
- **Volume Totalizer Increment -** This section shows how the totalizer registers for both Adjusted and Un-Adjusted volumes are incremented after the calculation are performed each second.

II. AAT Flow Chart

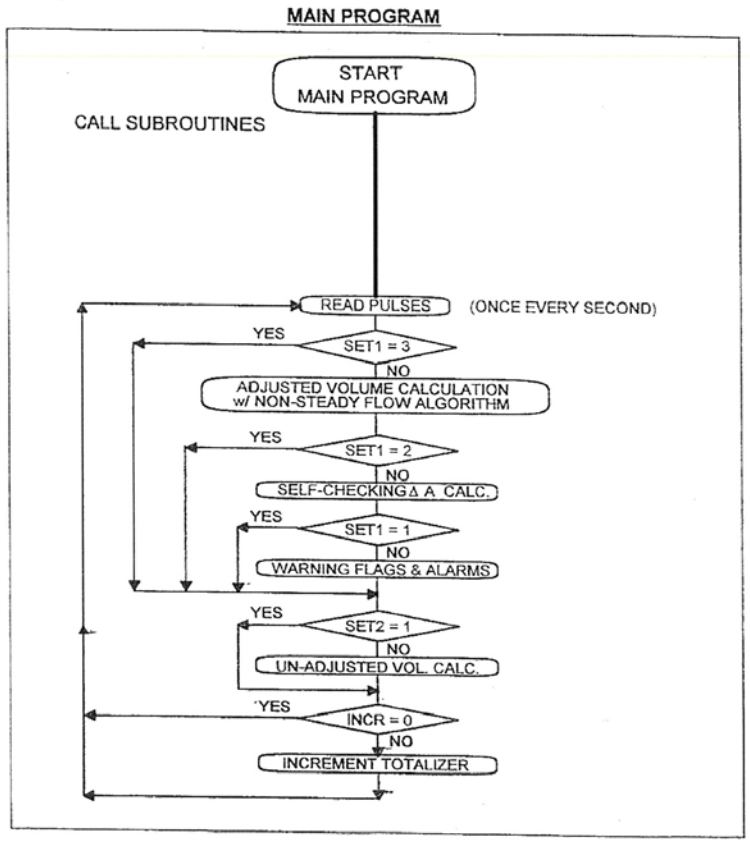
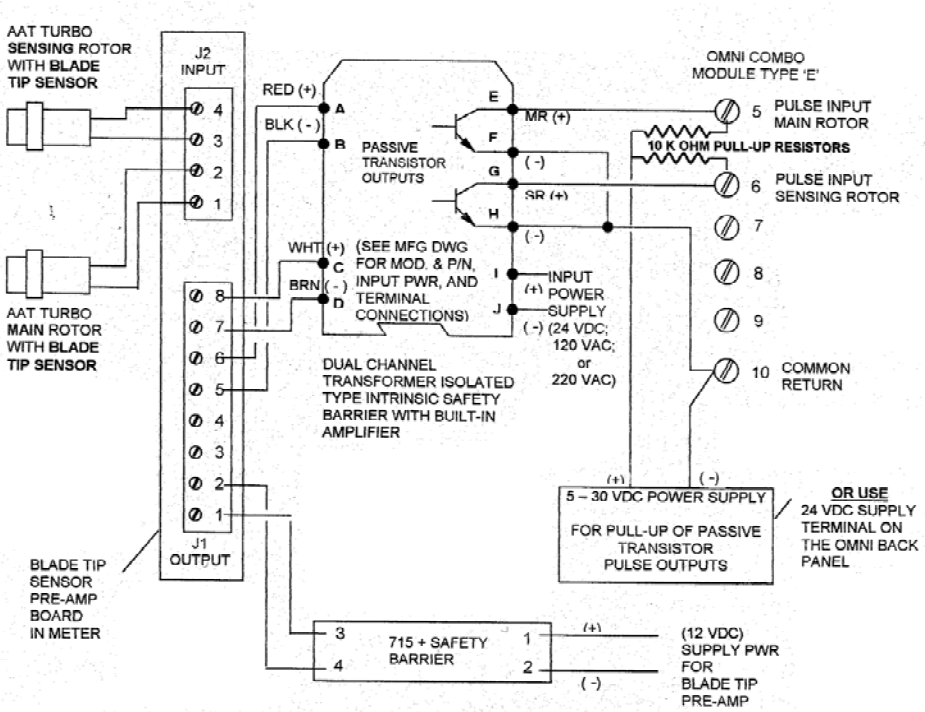


Figure 1. Flow Computer Logic Flow Diagram for the AAT Gas Flowmeter

Wiring Invensys Auto-Adjust® (AAT) Turbine Flowmeter (SLOT SENSOR) Signals to E Type Combo Modules (OMNI 6000 and 30000)

Input Channels 3 and 4 of each E Type Combo Module are used to input signals for turbine or PD flowmeters (Figure 2). Both channels share a common signal return at the OMNI terminals. Input threshold can be jumpered for +1 or +3.5 volt. Input coupling can be AC or DC (refer to Chapter 2). Hysteresis is approximately 0.5 volt.



Available Dual Channel Amplifiers

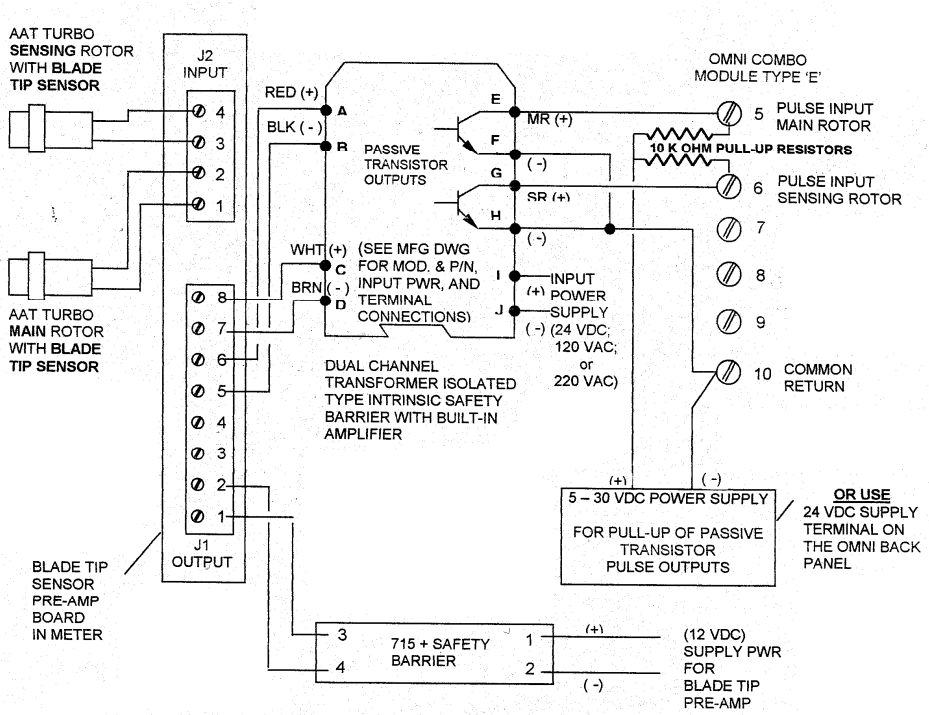
Invensys P/N	Model No.	Supply Power	Mailing Dwg No.
951342	KFD2-SOT/Ex 2-Y93522	24 VDC	MM-1890-B

Invensys P/N	A	B	C	D	E	F	G	H	I	J	Comments:
951342	2	3	5	6	8	7	10	9	11	12	Blade Tip Sensors

Figure 2. Slot Sensor Wiring

Wiring Invensys Auto-Adjust® (AAT) Turbine Flowmeter (BLADE TIP SENSOR) Signals to E Type Combo Modules (OMNI 6000 and 3000)

Input Channels 3 and 4 of each E Type Combo Module are used to input signals from turbine or PD flowmeters (Figure 3). Both channels share a common signal return at the OMNI terminals. Input threshold can be jumpered for +1 or +3.5 volt. Input coupling can be AC or DC (refer to Chapter 2). Hysteresis is approximately 0.5 volt.



Available Dual Channel Amplifiers

Invensys P/N	Model No.	Supply Power	Mailing Dwg No.
951342	KFD2-SOT/Ex 2-Y93522	24 VDC	MM-1890-B

Invensys P/N	A	B	C	D	E	F	G	H	I	J	Comments:
951342	2	3	5	6	8	7	10	9	11	12	Blade Tip Sensors

Figure 3. Blade Tip Sensor Wiring

Flow Computer Configuration

The flow computer configuration settings that are specific to the AAT flowmeter are entered in the miscellaneous configuration meter run menu and the meter run setup menu. You must enter the miscellaneous configuration meter run settings first and then proceed to the meter run setup entries. These configuration settings at this time can be entered via the OMNI Flow Computer's front panel keypad.

Miscellaneous Configuration Meter Run Settings

The following miscellaneous configuration meter run settings are required for each AAT gas flowmeter:

- ❑ **Select Flowmeter Device Type -** Enter **[7]** for each meter run that you want to select the AAT gas flowmeter as the device type.
- ❑ **Flow I/O Point -** Flowmeter pulse signals can only be assigned to the 3rd and 4th input channels of the E combo modules. Assign the Main Rotor pulse to the OMNI channel number that corresponds to the 3rd input channel on an E-Combo module and the flow computer program will assume the Sensing Rotor Pulse signal is wired to the 4th input channel of the same E-Combo module.

Meter Run Setup Entries

The following meter run setup entries are required for each AAT gas flowmeter:

- **M.R. Factor -**The Main Rotor (MR) Factor value (Pulses/MCF or /M^3) of an individual Auto-Adjust Turbine meter can be found on the METER FACTOR badge or on the factory calibration documents.
- **S.R. Factor -** The Sensing Rotor (SR) Factor value (Pulses/MCF or /M^3) of an individual Auto-Adjust Turbine meter can be found on the METER FACTOR badge or on the factory calibration documents.
- **M.O. Factor -** The Mechanical Output (MO) Factor value (Pulses/MCF or /M^3) of an individual Auto-Adjust Turbine meter can be found on the factory calibration curve for the meter. This value is determined mathematically from the mechanical output of the meter, change gears, internal gearing, and blades on the pulsar wheel.
- **A_Bar % -** The Average Relative Adjustment (A) value (%) of an individual Auto-Adjust Turbine meter can be found on the METER FACTOR badge or on the factory calibration documents. The purpose of the Adjusted volume calculation is to provide a measurement registration that is adjusted back to original factory calibration accuracy, compensating for meter changes or for abnormal flow conditions. These field or operating Delta_A values can be compared with those at factory calibration.
- **BTSF -** Blade Tip Sensor Factor (BTSF) for meter
- **AlarmBand H % -** Alarm band high limits %. The logic and algorithms in this section compare error conditions and Delta-A values to limits that are fixed or Operator selected. Delta_A above normal limits.
- **AlarmBand L % -** Alarm band low limits %. The logic and algorithms in this section compare error conditions and Delta-A values to limits that are fixed or Operator selected. Delta_A below normal limits.
- **Warning Hi % -** Alarm band high limits %. The logic and algorithms in this section compare error conditions and Delta-A values to limits that are fixed or Operator selected. Delta_A above normal operating limits.
- **Warning Lo% -** Alarm band low limits %. The logic and algorithms in this section compare error conditions and Delta-A values to limits that are fixed or Operator selected. Delta_A below normal operating limits.
- **AutoAdj Set (Set1) -** The adjusted volume calculation is done every 500mS cycle using pulses read from the Main and Sensing rotors of an Auto-Adjust Turbo-Meter. In addition to the adjusted volume equation, algorithms are included that provide corrections to the volume totalization for condition of Leakage flow, Resonant No-Net flow, Severe flow pulsation or Non-Steady flow.

  Set1 = 0; Enable the auto adjust volume calculation, self-checking, flags and alarms.

  Set1 = 1; Enable the auto adjust volume calculation, self-checking, disable flags and disable alarms.

  Set1 = 2; Enable the auto adjust volume calculation, disable self-checking, disable flags and disable alarms.

  Set1 = 3; Disable the auto adjust volume calculation, disable self-checking, disable flags and disable alarms.

- **Un-Adj Set (Set2) -** This section shows how the "Mechanical" or Un-Adjusted volume is properly calculated using the pulses from the Main rotor only. This volume is to be used in the measurement totalization when pulses from the Sensing rotor are unavailable or when the gas flow rate is below the minimum for the Adjusted output.

  Set2 = 0; Enable the UN-Adjusted volume calculation.

  Set2 = 1; Disable the UN-Adjusted volume calculation

Meter Run Data

To configure meter run setup on the flow computer LCD display, press **[Prog] [Meter] [*n*] [Enter]** on the OMNI front panel keypad (where "n" equals the meter run number, 1 to 4, you want to setup) when in the setup Mode. The following entries will display:

```
METER RUN #1

Meter ID
Select Product No.
GC Stream #
Flow Low
Flow High
G FullScal
M FullScal
Active Freq.
M.R.Factor
S.R.Factor
M.O.Factor
A_bar%
BTSF
AlarmBand H%
Alarm Band L%
Warning Hi %
Warning Lo %
AutoAdj Set
Un-Adj Set
Meter Factor
Meter Model
Meter Size
Serial No.
Select Trans Dens?
```

Warning and Alarm Messages

The following warning or alarm messages will be displayed when the alarm condition occurs:

```
AAT ABN Warning
AAT ABN Alarm
Non-steady Flow Alarm
Non-steady Flow Warning
No Flow or No Pulses (Both)
Leakage/Resonant No-Net Flow
No Main Rotor Pulses
No Sensing Rotor Pulses
```

Flow Computer Database Addresses and Index Numbers

The Tables 1 thru 4 list the Modbus database addresses within the OMNI assigned to the Auto-Adjust Turbo metering feature. These tables are categorized per data type.

Table 1. Meter Run Alarm & Status Points – Real Time Data

Description	Database Address for Meter Run Number				Description	Database Address for Meter Run Number			
	1	2	3	4		1	2	3	4
AAT ABN Warning	2178	2278	2378	2478	System Status Word	3158	3258	3358	3458
AAT ABN Alarm	2179	2279	2379	2479	Non-Steady Flow Status	3159	3259	3359	3459
Non-steady Flow Alarm	2180	2280	2380	2480	Auto Adj. Abnormal Status	3160	3260	3360	3460
Non-steady Flow Warning	2181	2281	2381	2481	Auto Adjust Alarm Status	3161	3261	3361	3461
No Flow or No Pulses (Both)	2182	2282	2382	2482	Warning/alarm message #1	4123	4223	4323	4423
Leakage/Resonant No-Net Flow	2183	2283	2383	2483	Warning/alarm message #2	4124	4224	4324	4424
No Main Rotor Pulses	2184	2284	2384	2484	Warning/alarm message #3	4125	4225	4325	4425
No Sensing Rotor Pulses	2185	2285	2385	2485					

Table 2. Meter Configuration & Setup Entry Data

Description	Database Address for Meter Run Number				Description	Database Address for Meter Run Number			
	1	2	3	4		1	2	3	4
M.R. Factor	17501	17601	17701	17801	Auto Adjust Set (Set 1)	3156	3256	3356	3456
S.R. Factor	17502	17602	17702	17802	Un-Adjusted Set (Set 1)	3157	3257	3357	3457
M.O. Factor	17503	17603	17703	17803					
A_Bar %	17504	17604	17704	17804					
Blade Tip Sensor (BTSF)	17505	17605	17705	17805					
Alarm Band High Limit %	17506	17606	17706	17806					
Alarm Band Low Limit %	17507	17607	17707	17807					
Warning Band High Limit %	17508	17608	17708	17808					
Warning Band Low Limit %	17509	17609	17709	17809					

Table 3. 32-Bit Integer Data

Description	Database Address for Meter Run Number				Description	Database Address for Meter Run Number			
	1	2	3	4		1	2	3	4
Sensing Rotor Pulses (Batch)	5196	5296	5396	5496					
Sensing Rotor Pulses (Daily)	5197	5297	5397	5497					
Cumulative Un-Adjusted Total	5198	5298	5398	5498					

Table 4. 32-Bit IEEE Floating Point Data

Description	Database Address for Meter Run Number				Description	Database Address for Meter Run Number			
	1	2	3	4		1	2	3	4
Previous Hour Average – Delta A	8528	8628	8728	8828					
Previous Day Average – Delta A	8546	8646	8746	8846					
Calculated Delta A	8569	8669	8769	8869					

DOCUMENT REVISION HISTORY

DOCUMENT INITIAL RELEASE DATE..... 14-March-2001

REVISION	DATE	PURPOSE / CHANGE REQUEST
A	14-March-2001	Maintained on the web - Initial release
B	19-June-2009	DCR 090208