IntelliPack Series 895M/896M Frequency Output Transmitters With Process Current/Voltage Inputs

USER'S MANUAL

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Safety Summary – Symbols on equipment:

Means "Caution, refer to this manual for additional information".

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IMPORTANT SAFETY CONSIDERATIONS

It is very important for the user to consider the possible adverse effects of power, wiring, component, sensor, or software failures in designing any type of control or monitoring system. This is especially important where economic property loss or human life is involved. It is important that the user employ satisfactory overall system design. It is agreed between the Buyer and Acromag, that this is the Buyer's responsibility.

1.0 INTRODUCTION

These instructions cover hardware functionality of the transmitter models listed in Table 1. Supplementary sheets are attached for units with special options or features.

Table 1: Models Covered in This Manual

Series/ Input/Type	-Options/Output/ Enclosure/Approvals[1]	-Factory Configuration[2]
895M[3]	-0800	-C
896M[3]	-0800	-C

Notes (Table 1):
1. Approvals: cULus Listed.
2. Include the "-C" suffix to specify factory configuration option. Otherwise, no suffix is required for standard configuration.
3. Model 896M-0800 units have two input channels, while 895M-0800 units have one input channel.

Module programming, transmitter operation, and the IntelliPack Configuration Software are also covered in the IntelliPack Transmitter Configuration Manual (8500-570).

DESCRIPTION

Series 895/896M Frequency Output Transmitters are members of the popular Acromag IntelliPack Transmitter & Alarm family. These models will accept one or two channels of DC current or voltage input, and provide an isolated pulse or square waveform output, whose frequency or duty cycle is controlled via a programmed mathematical operation operating on one or both input signals. Each channel also includes a solid-state output whose ON/OFF state is controlled via a separate equation. Each input, output, and control output has its own variable name that allows it to be included in any output equation. All units are fully reconfigurable via our user-friendly Windows 95/98® or NT® IntelliPack Configuration Program. IntelliPacks contain an advanced technology microcontroller with integrated down-loadable flash memory for non-volatile program, configuration, calibration, and parameter data storage. Once configured, these modules may operate independent of a host computer for true embedded computation, process monitoring, and control.

Module inputs may be field connected for either process current or DC voltage input signals. The 896M provides two current or voltage inputs, while the 895M provides one current or voltage input. Mathematical operators and embedded functions may be applied to one or both input signals to control either output frequency or duty cycle, depending on the output response type selected. Three types of output response are possible: a frequency output with variable frequency in Hertz and fixed 50% duty cycle, a pulse-width modulated output with a fixed output frequency and variable duty cycle, and a low frequency output pulse in counts per hour with a fixed pulse ON-time. Equations for each output and each control output can be configured and may include variables that represent the input signal, output signal, or control output state. A wide variety of math and logical operators and functions are provided. The module also includes low dropout function support which allows a minimum input level to be defined that below which, a zero input is assumed. A status indicator on the front of the module flashes for input signals in the low dropout region.

This module includes open-drain frequency outputs with optional pullups to +5V built-in. The open-drain frequency output can be used to drive electronic counters (TTL or CMOS) directly (using the internal pullup), or it can be used to drive electro-mechanical counters when connected to an external DC power source. For output frequency ranges from 10Hz to 10,000Hz full-scale, the unit outputs a 50% duty-cycle pulse waveform. For output frequency ranges from 10CPH to 100,000CPH full-scale, the duty cycle defaults to a 50ms ON-time pulse width, but may be alternately specified from 1ms to 255ms. A yellow LED for each channel indicates input over/under-range status, plus zero dropout status. A green "Run" LED indicates power and operation status. Each channel also includes wire terminals that may be used to externally signal the module to hold the corresponding transmitter output at the last value.

In addition to the frequency outputs, these modules include an isolated, solid-state, control output switch for each input that will change states via its own control equation. Each channel includes a yellow LED on the front of the module to provide visual indication of the switch ON/OFF state.

The module uses a high resolution, low noise, Sigma-Delta, Analog to Digital Converter (Σ-Δ ADC) to accurately convert the input signals into digitized values. All scaling and computation is performed using single-precision, floating point arithmetic within the main microcontroller. Separate optically-isolated slave controllers provide counter and timer regulation of the output waveform for precise and accurate control.

All IntelliPack modules are designed to withstand harsh industrial environments. They feature RFI, EMI, ESD, EFT, and surge protection, plus low temperature drift, wide ambient temperature operation, and isolation between input, output, and power. They also have low radiated emissions per CE requirements. As a wide-range DC-powered device, the unit may be powered from DC power networks incorporating battery back-up. Additionally, the input power terminal is diode-coupled, providing reverse polarity protection. This allows the unit to be connected to redundant power supplies, or several units to safely share a single DC supply.

Units are DIN-rail mounted and removable terminal blocks facilitate ease of installation and replacement, without having to remove wiring. Transmitter power and output wiring are inserted at one side of the unit, while input wiring is inserted at the other side. Connectors are an industry standard screw clamp type and accept a wide range of wire sizes.

Variable input and output ranges, generous math and logical operation support, flexible power requirements, plus convenient reprogrammability makes this instrument extremely powerful and useful over a broad range of applications. For example, it can be used in telemetry systems where the DC signal is converted to a frequency, transmitted over long lines, then converted back to a DC signal at the receiving end by means of a frequency to DC converter. It can also be used as a frequency input to a PLC. When connected to a counter at the output, the module may be used in totalizing applications, where the total number of pulses counted in a given time period represents the time integral of the DC input. That is, if the input represents flow in gallons per hour, then the time integral of this flow signal (total count) will represent total gallons. Another use involves varying pulse-width on-time as a function of the input signal at any frequency from 1 to 10KHz. The safe, compact, rugged, reconfigurable, and reliable design of this transmitter makes it an ideal choice for control room and field applications. Custom IntelliPack module configurations are also possible (please consult the factory).

Key IntelliPack 895M/896M Features

- **Easy Windows® Reconfiguration** - Via the user friendly Windows 95/98® or NT® IntelliPack Configuration Program.
- **Separate Frequency & Control Output Equations** - Each output (frequency or pulse-width) is controlled via its own output equation. The state of the control outputs is also driven by their own equations.
- **Supports Integrator/Totalizer Applications** - When used with a counter, these models can be used to integrate and totalize input signals representing such process variables as flow, weight, power, and BTU's. Math support allows this module to be configured with a linear response, square-root response, or other user-defined integrator/totalizer type.
- **Generous Mathematical Operator & Function Support** - This transmitter may mathematically combine one or two inputs or outputs using addition, subtraction, multiplication, and division. In addition, functions for square root, absolute value, min/max detection, exponential, logarithmic, power, sine, cosine, tangent, arc-sine, arc-tangent, and arc-cosine generation are supported. Conditional constructs with IF-THEN-ELSE are included. Variables are provided for each input and output. Initial output values may be assigned and take effect following power-up or a reset until the internal computation takes control of the output. Other functions are possible—please consult the factory.
- **IF-THEN-ELSE Support** - Evaluates conditional statements IF-THEN-ELSE, AND, OR, plus >, >=, <, <=, =, and <>.
- **Supports Pulse-Width Modulation** - A fixed output frequency from 1Hz to 10KHz may have its pulse width modulated between a minimum specified duty cycle and maximum specified duty cycle with 0.1% resolution. PWM outputs may be used in stepper controls, servo systems, light dimmer controls, and variable frequency drives.
- **Supports Frequency Output Over Wide Range** - This module can generate a square-wave output waveform in the range of 0 to 10KHz (50% duty cycle). Low frequency ranges in counts per hour are also supported and allow the pulse ON-time to be specified (see below).
- **Generates Accurate Low Frequency Pulses in CPH** - Accurate low frequency pulse trains may be generated from 0 to 100000 Counts Per Hour (10 CPH minimum span). The pulse ON-time may be configured from 1 to 255ms, or a 50% duty cycle may be used (On-Time=0).
- **Includes Solid-State Control Outputs w/ LED Indication** - Each input includes an isolated solid-state control output (a normally open 1 Form A switch) that is controlled via separate user-defined control output equations. These outputs may switch up to 60VDC at 500mA. Variables that represent the current state of these outputs may be included in output equations. A yellow "CONTROL" LED for each output is included to indicate the switch "ON" condition.
- **High Voltage & Current Open Drain Outputs** - The open drain outputs of this module may switch up to 60VDC at 1A.
- **Output HOLD Function** - An external HOLD input terminal is provided to optionally signal the module to hold the module's corresponding frequency output at the last value.

Key IntelliPack 895M/896M Features…continued

- **Zero Drop Out Functionality** - A zero drop out level from 0 to 10% of input span can be specified and the module will evaluate input signals below this level as equivalent to zero. The channel's corresponding STATUS LED will blink to indicate input signals in the zero drop out region.
- **Convenient Scaling to Engineering Units** – I/O signals are easily scaled to units/ ranges to fit your application.
- **Nonvolatile Reprogrammable Memory** - This module has an advanced technology microcontroller with integrated, non-volatile, downloadable flash memory. This allows the functionality of this device to be reliably reprogrammed thousands of times.
- **Fully Isolated** - Input, frequency outputs, control outputs, and power are isolated from each other for safety and increased noise immunity. Inputs share common and are not isolated channel-to-channel. Frequency outputs share common and are not isolated output-to-output. Control outputs are separately isolated.
- **Convenient Output Excitation Supply** - The open-drain outputs may use the internal 470Ω pullups to +5V, or external pullups to some other supply up to 60VDC.
- **Flexible DC Current or Voltage Inputs** - Each input is individually configurable for several ranges of process current or voltage, without changing models.
- **Wide-Range DC-Powered** - This device operates from a wide DC supply range and the power terminal is diode-coupled. This makes this transmitter useful for systems with redundant supplies, and/or battery back-up.
- **Wide Ambient Operation** - The unit is designed for reliable operation over a wide ambient temperature range.
- **Hardened For Harsh Environments** - The unit will operate reliably in harsh industrial environments and includes protection from RFI, EMI, ESD, EFT, and surges, plus low radiated emissions per CE requirements.
- **Convenient Mounting, Removal, & Replacement** - The DIN-rail mount and plug-in type terminal blocks make module removal and replacement easy.
- **High-Resolution Precise A/D Conversion** - Includes a high-resolution, low noise, Sigma-Delta, Analog-to-Digital Converter (Σ-Δ ADC) for high accuracy and reliability.
- **LED Indicators** - Used to indicate power, operation, alarm, zero-dropout, and channel over/under-range status.

ACCESSORY ITEMS

The following IntelliPack accessories are available from Acromag. Acromag also offers other standard and custom transmitter and alarm types to serve a wide range of applications (please consult the factory).

IntelliPack Configuration Software (Model 5030-881)

IntelliPack alarms and transmitters are configured with this user-friendly Windows 95/98® or NT® Configuration Program. This software package includes the IntelliPack Alarm Configuration Manual (8500-563) and IntelliPack Transmitter Configuration Manual (8500-570). These manuals describe software operation and various alarm and transmitter functions in detail. The Configuration Software also includes an on-line help function. All transmitter and alarm functions are programmable and downloadable to the modules via this software. Non-volatile memory provides program, configuration, and data storage within the IntelliPack.

IntelliPack Serial Port Adapter (Model 5030-913)

This adapter serves as an isolated interface converter between the EIA232 serial port of the host computer and the Serial Peripheral Interface (SPI) port of the IntelliPack module. It is used in conjunction with the Acromag IntelliPack Configuration Software to program and configure IntelliPack modules. This adapter requires no user adjustment, no external power, and operates transparent to the user. It receives its power from the IntelliPack module. The adapter has a DB9S connector that mates to the common DB9P serial port connector of a host computer. The adapter also has a 6-wire RJ11 phone jack to connect to the IntelliPack alarm module via a separate interconnecting cable (described below). Refer to Drawing 4501-747 for computer to IntelliPack connection details.

IntelliPack Cable (Model 5030-902)

This 6-wire cable is used to connect the SPI port of the IntelliPack Serial Port Adapter to the IntelliPack. This cable carries the SPI data and clock signals, reset signal, and +5V power and ground signals. The cable is 7 feet long and has a 6-wire RJ11 plug at both ends which snap into jacks on the Serial Port Adapter and the IntelliPack module.

IntelliPack USB-to-RS232 Serial Adapter (P/N 4001095)

This adapter is used to add a traditional RS232 serial port to newer personal computers or laptops that do not support legacy RS232 serial ports, but may have USB serial support. This adapter requires no user adjustment, no external power, and operates transparent to the user. The adapter has a USB connector at one end of a 6 foot cable for connection to a host computer, and a DB9P connector at the other end for connection to serial port adapter 5030-913 of this kit. Refer to Drawing 4501-747 for computer to IntelliPack connection details.

IntelliPack Software Interface Package (Model 800C-SIP)

The IntelliPack Software Interface Package combines the Configuration Software (5030-881), Transmitter Configuration Manual (8500-570), Alarm Configuration Manual (8500-563), Serial Port Adapter (5030-913), USB-to-RS232 Serial Adapter, and Cable (5030-902), into a complete kit for interfacing with IntelliPack Transmitters and Alarms.

2.0 PREPARATION FOR USE

UNPACKING AND INSPECTION

Upon receipt of this product, inspect the shipping carton for evidence of mishandling during transit. If the shipping carton is badly damaged or water stained, request that the carrier's agent be present when the carton is opened. If the carrier's agent is absent when the carton is opened and the contents of the carton are damaged, keep the carton and packing material for the agent's inspection. For repairs to a product damaged in shipment, refer to the Acromag Service Policy to obtain return instructions. It is suggested that salvageable shipping cartons and packing material be saved for future use in the event the product must be shipped.

This module is physically protected with packing material and electrically protected with an anti-static bag during shipment. However, it is recommended that the module be visually inspected for evidence of mishandling prior to applying power.

This circuit utilizes static sensitive components and should only be handled at a static-safe workstation.

INSTALLATION

The transmitter module is packaged in a general purpose plastic enclosure. Use an auxiliary enclosure to protect the unit in unfavorable environments or vulnerable locations, or to maintain conformance to applicable safety standards. Stay within the specified operating temperature range. As shipped from the factory, the unit is factory calibrated for all valid input ranges and has the default configuration shown in Table 3 below.

WARNING: Applicable IEC Safety Standards may require that this device be mounted within an approved metal enclosure or sub-system, particularly for applications with voltages greater than or equal to 75VDC or 50VAC.

Table 3: 895M/896M Default Factory Configuration[1]

PARAMETER	CONFIGURATION/CALIBRATION
Input 1 Range[3]	0 to 10V DC
Input 1 Zero Dropout	0.0%
Input 2 Range[3]	0 to 10V DC
Input 2 Zero Dropout	0.0%
Output 1 Range Type	Frequency (Hertz)
Output 2 Range Type	Frequency (Hertz)
Input 1 Scaling	0V = 0%; 10V = 100%
Output 1 Scaling	0Hz=0; 10KHz = 100
Input 2 Scaling	0V = 0%; 10V = 100%
Output 2 Scaling	0Hz=0; 10KHz = 100
Output 1 Equation[2]	A
Control Out 1 Equation[2]	A > 50
Output 2 Equation[2]	D
Control Out 2 Equation[2]	D > 50

Notes (Table 3):
1. Shaded entries apply to 896M-0800 units only which have two I/O channels.
2. Variables A, B, C, D, E, and F are used in the output equations to represent input 1, output 1, control output 1, input 2, output 2, and control output 2, respectively.
3. For process current input ranges, a short jumper wire must be inserted between the input “I+” and “V+” terminals (not included). This jumper is removed for voltage input ranges.

Your application may differ from the default configuration and will require that the transmitter be reconfigured to suit your needs. This is accomplished with Acromag’s user-friendly Windows 95/98® or NT® Configuration Program and Serial Port Adapter. It is usually more convenient to configure the module prior to field installation. See Software Configuration for details and refer to the Transmitter Configuration Manual (8500-570) for additional instructions.

Jumper Installation (Current Input)

For process current input, a short jumper wire must be installed between the input “I+” and “V+” terminals. This jumper is not included from the factory. Remove this jumper for voltage input applications. Refer to the Electrical Connections Drawing 4501-744.

Pullup Installation (Open-Drain Frequency Output)

The frequency outputs are an open-drain type and require a pullup resistor to complete the drive circuit (see Drawing 4501-744). Internal pullups of 470Ω to +5V are provided at the PUL1 and PUL2 terminals. Simply install a jumper between the open-drain output (FRQ1 or FRQ2) and the pullup terminal (PUL1 or PUL2). This will be adequate for building a simple logic level interface for TTL and CMOS, but may be inadequate for other interfaces requiring higher voltages and currents. As such, outputs may also be pulled up externally by installing an appropriate pullup resistor between the open drain output and an external excitation supply up to 60VDC (do not connect to PUL1 or PUL2). Limit drain currents to less than 1A. Configure the output pullup(s) as required by your application. Refer to the Electrical Connections Drawing 4501-744.

Mounting

Refer to Enclosure Dimensions Drawing 4501-745 for mounting and clearance dimensions.

DIN Rail Mounting: This module can be mounted on "T" type DIN rails. Use suitable fastening hardware to secure the DIN rail to the mounting surface. Units may be mounted side-by-side on 1-inch centers for limited space applications. **"T" Rail (35mm), Type EN50022:** To attach a module to this style of DIN rail, angle the top of the unit towards the rail and locate the top groove of the adapter over the upper lip of the rail. Firmly push the unit towards the rail until it snaps solidly into place. To remove a module, first separate the input terminal block(s) from the bottom side of the module to create a clearance to the DIN mounting area. Next, insert a screwdriver into the lower arm of the DIN rail connector and use it as a lever to force the connector down until the unit disengages from the rail.

Electrical Connections

Terminals can accommodate wire from 14-26 AWG (stranded or solid), or 12 AWG stranded. Strip back wire insulation 1/4-inch on each lead before installing into the terminal block. Input wiring should be shielded twisted-pair. Since common mode voltages can exist on signal wiring, adequate wire insulation should be used and proper wiring practices followed. It is recommended that transmitter output and power wiring be separated from the input signal wiring for safety, as well as for low noise pickup. Note that input, power, and output terminal blocks are a plug-in type and can be easily removed to facilitate module removal or replacement without removing individual wires. If your input is process current, you must install a short jumper wire between the input “I+” and “V+” terminals to complete the input circuit. Be sure to remove power and/or disable the load before unplugging the terminals to uninstall the module, installing or removing jumpers, or before attempting service. All connections must be made with power removed.

CAUTION: Risk of Electric Shock - More than one disconnect switch may be required to de-energize the equipment before servicing.

1. **Power:** Refer to Electrical Connections Drawing 4501-744. Variations in power supply voltage within rated limits has negligible effect on module accuracy. For supply connections, use No. 14-24 AWG wires rated for at least 90°C. The power terminal is diode-coupled for reverse polarity protection. Choose a power supply capable of providing the maximum steady state current draw of the module, plus the peak inrush current that is required when power is first switched on, or startup problems may occur. As a general rule, the peak current approaches twice the maximum steady state current. Peak currents are reduced with higher supply voltages.

2. **DC Voltage/Current Inputs:** Connect input(s) per Drawing 4501-744. Observe proper polarity (see label for input type). For process current input, the input "I+" terminal must be jumpered to the input "V+" terminal. Place a short jumper between these terminals to complete the input circuit for current inputs only. Otherwise, voltage is delivered to the "V+" input directly with this jumper removed.

   Optional HOLD Wiring: A TTL or open collector/drain signal may be wired to the hold (labeled "HLD1" & "HLD2") and return (HRTN) terminals of the module to *hold* the transmitter's corresponding output at the last value while HOLD is asserted low (only the analog output is held, not the engineering units computation). HOLD is pulled-up internally (deasserted) and is part of the input circuit which is isolated from the output. HOLD return (HRTN) and input return (RTN) are not equivalent potentials and should never be tied together. Make sure that HOLD return is not inadvertently tied to ground which may be connected to input return.

3. **Frequency Output Connections**: Wire outputs as shown in Electrical Connections Drawing. Observe proper polarity. Either install a jumper from the open-drain output to the pullup terminal, or wire a pullup resistor to an external supply as appropriate to your application (see Pullup Installation).

   Additional Output Protection: The open-drain outputs of this module already include a shunt-diode from drain-to-source to absorb the reverse potential that may develop while switching inductive loads. However, to further protect the circuit and increase its useful life, external protection local to the load is recommended, especially with inductive loads. For DC inductive loads, place a diode across the load (1N4006 or equivalent) with cathode to (+) and anode to (-).

   IMPORTANT - For Increased Noise Immunity: For low current applications, such as driving simple logic level inputs, a 50Ω resistor connected in series with the output will significantly reduce the negative effects of ground bounce in the output signal at the signal transitions. This bounce may cause false triggering of counter/timers or other high speed inputs and produce erroneous or erratic readings. To further reduce transition noise and ground bounce, outputs should be properly grounded.

4. **Control Output Connections**: Wire the solid-state relay outputs as shown in Electrical Connections Drawing 4501-744. Observe proper polarity. Output control is limited to voltages less than 60V DC and currents below 500mA. If necessary, an interposing relay can be used to switch higher currents.

   Solid-State Relay Contact Protection: The solid state control outputs of this module already include a shunt-diode to absorb the reverse potential that may develop while switching inductive loads. However, to maximize relay life with inductive loads and minimize radiated energy, external protection local to the load is recommended. For DC inductive loads, place a diode across the load (1N4006 or equivalent) with cathode to (+) and anode to (-).

5. **Grounding:** See Electrical Connections Drawing 4501-744. The module housing is plastic and does not require an earth ground connection.

WARNING: For compliance to applicable safety and performance standards, the use of shielded cable is recommended as shown in Drawing 4501-744. Further, the application of earth ground must be in place as shown in Drawing 4501-744. Failure to adhere to sound wiring and grounding practices may compromise safety & performance.

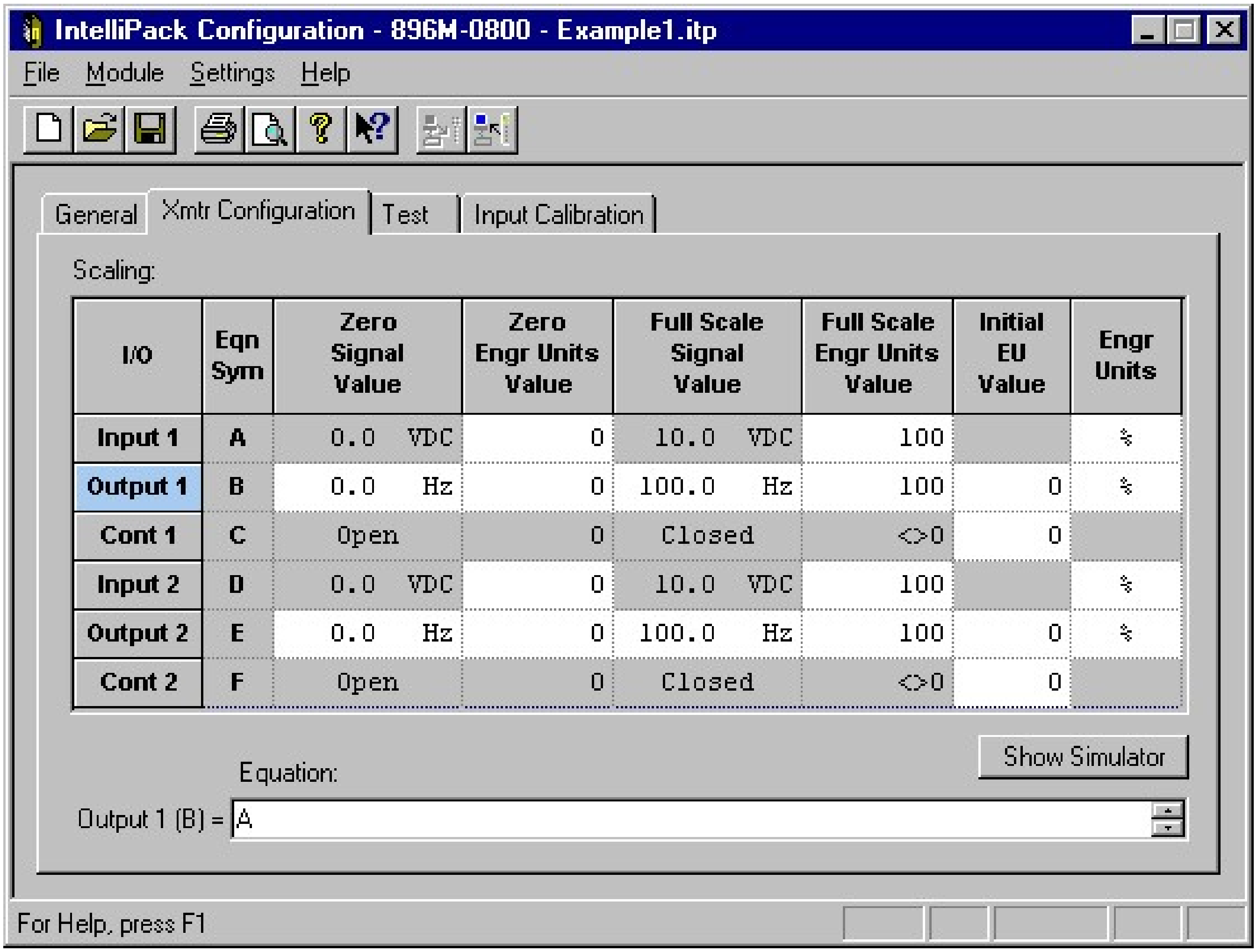
3.0 MODULE CONFIGURATION

This computation transmitter needs to be configured for your application. Input and output ranges must be scaled and equations that relate the input, output, and control variables must be entered for the frequency and control outputs. Configuration is done using Acromag's Windows 95/98® or NT® IntelliPack Configuration Program and Serial Port Adapter. Additional transmitter configuration details are included in the IntelliPack Transmitter Configuration Manual (8500-570) and in Section 6 of this manual. The following section provides information regarding the formulation of the equation that relates the input signal(s) to the outputs of this module.

MATH FORMULATION

Three types of output response are configurable via this module: 1) a variable high frequency square waveform from 0Hz to 10Hz to 0 to 10KHz (50% duty cycle), 2) a variable low frequency pulse train from 0-10 counts per hour (CPH) to 0-100,000 counts per hour with a fixed specified ON-time, and 3) a fixed output frequency of 1Hz to 10KHz with a variable duty-cycle from a specified minimum duty cycle to a maximum duty cycle with 0.1% resolution. In each of these configurations, either the output frequency or the duty cycle (but not both simultaneously) is being varied in response to the input signal(s) with applied math formulation and scaling. Variables that represent the inputs, outputs, and control outputs may be combined with constants, math operators, functions, and logical operators to perform complex input to output conversion and control. An optional HOLD signal may be wired to the module at the hold terminals (HLD1, HLD2, HRTN) and is asserted low to hold the analog output at the last value (hold does not hold the engineering units computation, only the resultant analog output).

The IntelliPack Configuration Software provides the interface for scaling the input and output values, and entering the frequency and control output equations via the transmitter configuration screen shown on the following page.



I/O	Eqn Sym	Zero Signal Value	Zero Engr Units Value	Full Scale Signal Value	Full Scale Engr Units Value	Initial EU Value	Engr Units
Input 1	A	0.0 VDC	0	10.0 VDC	100		%
Output 1	B	0.0 Hz	0	100.0 Hz	100	0	%
Cont 1	C	Open	0	Closed	<>0	0	
Input 2	D	0.0 VDC	0	10.0 VDC	100		%
Output 2	E	0.0 Hz	0	100.0 Hz	100	0	%
Cont 2	F	Open	0	Closed	<>0	0	

The 895M/896M will mathematically combine the scaled input signal value(s) according to a preprogrammed output equation entered via the IntelliPack Configuration Software. In the Transmitter Configuration Screen shown above, a simple edit box is provided to enter each output equation that operates on the scaled input and output values from each channel. Use the scroll arrows to the right of the equation field to cycle through each output equation. Equations are entered in a free-form format, similar to entering a cell formula in Microsoft Excel. The equation combines standard math operators and functions, with floating point constants, and variables that represent the scaled input channel value(s), the current output values, and the current control output values. The variables A, B, C, D, E, and F are used in the output equations to represent the scaled equivalent values of input 1, output 1, control output 1, input 2, output 2, and control output 2, respectively (see Table 3). The module will operate on scaled I/O values and compute a solution to the output equation, then scale the computed value to the desired output frequency or duty cycle, depending on the output type configured. Initial output values are defined and take effect following power-up or reset, until the computation takes control of the corresponding output.

All scaling and computation is performed using single precision, floating point arithmetic. A simulator is provided to check scaling and computation for each channel. Click on the Show Simulator button to use this feature.

It is important to note that the built-in equation interpreter operates on *scaled* input and output values only. Scaled values are floating-point numbers in the engineering units of your application and are limited to 8 characters. Large numbers may be entered in scientific notation (i.e. 123456E3). Each input, plus the output must be scaled. That is, for each input, you must specify a scaled value in engineering units for the nominal zero and full-scale input range endpoints which use mA or volts, according to the input range configured. You must also specify a scaled value in engineering units for the nominal zero and full-scale output range endpoints which use Hz, CPH, or %, according to the output range configured. The nominal output zero and full-scale endpoints may also be defined (i.e. a subset of the output range may be used), while the input zero and full-scale endpoints are fixed per the configured input range.

The computed output value in engineering units, is then scaled to output frequency (Hz or CPH), or duty cycle (%), using the zero and full-scale frequency endpoints of the desired output range, or the minimum and maximum duty cycle of a specified fixed output frequency, depending on the output range selected. The output signal is then updated accordingly if HOLD is not asserted. Note that the hold signal does not hold the computation, only the resultant analog output, and has no effect on the control output. For example, 4-20mA channel 1 can be scaled to 0-5000Hz at the output—the 4mA input signal endpoint is scaled to 0Hz and the 20mA full-scale signal is scaled to 5000Hz. In this case, the engineering units correspond directly to the output units, but this is not required.

Up to 200 characters may be entered into the output equation fields to define a formula that relates the scaled I/O values to the scaled output value. Note that equation constants can be entered as floating point numbers, or in scientific notation. Equation operators are shown in Table 3 below. Channels 1 and 2 may have different input and range type configurations.

Table 3A: IntelliPack 896M/895M Math Operators

OPERATOR	DESCRIPTION
+	Add (Do Not Use “+” To Indicate Polarity)
-	Subtract or unary minus for constants
*****	Multiply
/	Divide
(	Left Parenthesis
)	Right Parenthesis
e	A constant followed by the suffix “e” or “E” represents scientific notation and a power of 10 follows (i.e. 10e8 = 100,000,000.0).
A	Represents the scaled value of input 1
B	The current scaled value of output 1
C[5]	The current state of control output 1. Note: C= 0.0 = False (Switch Open); C not equal to 0.0 implies True (Switch Closed).
D	Represents the scaled value of input 2
E	The current scaled value of output 2
F[5]	The current state of control output 2. Note: F= 0.0 = False (Switch Open); F not equal to 0.0 implies True (Switch Closed).

Table 3B: IntelliPack 896M/895M Math Functions

Table 3B: IntelliPack 896M/895M Math Functions

FUNCTION	DESCRIPTION
MIN(*n1,n2,..,n5*)	Return the minimum value of two to five channels, numbers, or expressions.
MAX(*n1,n2,..,n5*)	Return the maximum value of two to five channels, numbers, or expressions.
SQRT(*n1*) *n1>=0*	Return the square root of a channel, number, or expression.
ABS(*n1*)	Return the absolute value of a channel, number, or expression.
EXP(*n1*)	Compute the exponential (e^{n1}) of a channel, number, or expression.
LN(*n1*) *n1 > 0*	Compute the natural logarithm (base *e*) of a channel, number, or expression.
LOG10(*n1*) *n1 > 0*	Compute the base 10 logarithm of a channel, number, or expression.
POWER(*n1,n2*)	Compute channel, number, or expression n1 raised to the n2 power ($n1^{n2}$).
SIN(*n1*) *n1 is in radians*	Compute the sine of a channel, number, or expression.
COS(*n1*) *n1 is in radians*	Compute the cosine of a channel, number, or expression.
TAN(*n1*) *n1 is in radians*	Compute the tangent of a channel, number, or expression.
ASIN(*n1*) *-1 <= n1 <= 1*	Compute the arc-sine ($\sin^{-1}$, $-\Pi/2 <=$ radians $<= \Pi/2$) of a channel, number, or expression.
ACOS(*n1*) *-1 <= n1 <= 1*	Compute the arc-cosine ($\cos^{-1}$, 0 <= radians <= Π) of a channel, number, or expression.
ATAN(*n1*)	Compute the arc-tangent ($\tan^{-1}$, $-\Pi/2 <=$ radians $<= \Pi/2$) of a channel, number, or expression.
IF(*condition*) **THEN(*n1*)** **ELSE(*n2*)**	Conditional Expression. If the conditional expression is true, then the expression *n1* is performed, otherwise the expression *n2* is performed. Can only be used one time in a formula. ELSE must be included.
AND(*n1,n2,..,n5*)	Conditional construct AND of two to five channels, numbers, or expressions. True if all n1..n5 are true.
OR(*n1,n2,..,n5*)	Conditional construct OR of two to five channels, numbers, or expressions. True if any one or more of n1..n5 are true.
XOR(*n1,n2*)	Conditional construct Exclusive OR of two to five channels, numbers, or expressions. True if either of n1 or n2 are true, but not both.
NOT(*n1*)	Conditional construct for inversion of a channel, number, or expression. True if n1 is false.
<	Conditional construct -less than.
<=	Conditional construct -less than or equal to.
>	Conditional construct -greater than.
>=	Conditional construct -greater than or equal to.
=	Conditional construct -equal to.
<>	Conditional construct -not equal to.

Notes (Tables 3A & 3B):

1. In the table, “*n*” is used to represent a channel variable, number, or expression (another function or equation).
2. Do not use the plus symbol as a polarity indicator, it is only used for the add operation.
3. Do not type or embed space between the sign of a number and the number itself.
4. Do not type or embed space between the function keyword and left parenthesis.
5. The use of control variables C & F within an equation will return the result of their respective computation equations, not their “0” or “1” states.

Show Simulator

The IntelliPack Configuration Software also provides a Show Simulator function that you can use to test your input formulation and ensure that a correct output response within range is produced, without having to drive the inputs with real world signals. For each input, a slider control is provided to simulate the input signal. For fine control of the slider, use the left and right arrow keys. The corresponding output value is displayed using scaled units, and signal units (%, Hz, or CPH).

Computations that return values beyond the defined range will be “clipped” to the minimum or maximum scaled values to ensure that a valid output response is always returned. Error checking in this area is limited, and it is up to the user to verify correct output formulation for all possible conditions of input. As such, use of the Show Simulator function is highly recommended for critical control applications.

The following example equations are entered into the Equation field exactly as they are shown below to the right of the equal “=” sign.

Equation Examples

Compute a simple linear output response to the input signal:
OUTPUT 1 (B) = A

Compute a square root output response to the input signal:
OUTPUT 1 (B) = SQRT(MAX(0,A))

Note that the use of the MAX function in the above example will prevent negative input signals from being computed.

Compute the average of both input signals:
OUTPUT 1 (B) = (A + D)/2

Compute the smallest square root of 2 input signals:
OUTPUT 1 (B) = MIN(SQRT(ABS(A)), SQRT(ABS(D)))

Compute the square of the scaled value of input 1:
OUTPUT 1 (B) = POWER(A,2)

Compute the sum of the minimum and maximum of 2 signals:
OUTPUT 1 (B) = MIN(A, D) + MAX(A, D)

Compute the maximum of 2 input signals greater than 10:
OUTPUT 1 (B) = MAX(A, D, 10)

Examples of Conditional expressions follow:
OUTPUT 1 (B) = IF(AND(A>D,A>10)) THEN(A*2) ELSE(D*3)
OUTPUT 1 (B) = IF(OR(A>=D,A=50)) THEN(A) ELSE(D) - 12.56

Implement a control output equation for C with a high setpoint above A=50 and a deadband of 2:

C=IF(OR(AND(C=0, A>50), AND(C=1, A>48))) THEN(1) ELSE(0)

or simplified
C=OR(AND(C=0, A>50), AND(C=1, A>48))

or simplified further
C=OR((A>50), AND(C=1, A>48))

When formulating an equation or response, it is important to keep the limits of module resolution in mind (see Table 5). In some cases, it may be necessary to normalize your variables or output response. Always use the Show Simulator function to test your equation over the full range of input to ensure a valid output response. A computation that returns a value beyond the defined range will be “clipped” to the minimum or maximum scaled values to ensure a valid response is always returned. Due to memory constraints of the module, some lengthy equations may be too complex and an error will be indicated in the Show Simulator screen.

For additional help with your computation and to view other examples, use the online HELP function of the Configuration Software.

4.0 THEORY OF OPERATION

Refer to Simplified Schematic 4501-741 and Functional Block Diagram 4501-743 to gain a better understanding of the circuit. Note that this transmitter will pre-filter a signal and convert the signal to a scaled voltage--either through a voltage divider circuit (voltage input), or a current sink resistor (current input). An A/D converter stage then applies appropriate gain to the signal, performs analog-to-digital conversion, and digitally filters the signal. The digitized signal is then transmitted serially to the main microcontroller. The main microcontroller completes the transfer function for the frequency output(s) and the control output(s) according to its configuration and programmed equation. The main microcontroller then serially transmits a scaled output signal to optically isolated slave controllers, one per output channel. The slave controller uses its internal counter/timer to regulate the output frequency or pulse-width under direction of the main controller. The main controller also switches the corresponding control outputs on or off according to the resultant of the control output equation. Embedded configuration and calibration parameters are stored in non-volatile memory integrated within the microcontroller. Only the functions required by an application are actually stored in memory—new functionality can be downloaded via the IntelliPack Configuration Program and Serial Port Adapter. A wide input range switching regulator (isolated flyback mode) provides isolated +5V power to the circuit, plus an isolated +5V output circuit supply.

5.0 SERVICE AND REPAIR

WARNING: To prevent electric shock, be sure to remove power and/or disable the load before unplugging terminals to uninstall the module or before attempting service. All connections must be made with power removed.

SERVICE AND REPAIR ASSISTANCE

This module contains solid-state components and requires no maintenance, except for periodic cleaning and transmitter configuration parameter (zero, full-scale, scaling, etc) verification. Since Surface Mounted Technology (SMT) boards are generally difficult to repair, it is highly recommended that a non-functioning module be returned to Acromag for repair. The board can be damaged unless special SMT repair and service tools are used. Further, Acromag has automated test equipment that thoroughly checks and calibrates the performance of each module. Please refer to Acromag’s Service Policy Bulletin or contact Acromag for complete details on how to obtain service parts and repair.

PRELIMINARY SERVICE PROCEDURE

Before beginning repair, be sure that all installation and configuration procedures have been followed. The unit routinely performs internal diagnostics following power-up or reset. During this period, all LED’s will turn ON momentarily, and the green “Run” LED flashes. If the diagnostics complete successfully, the “Run” LED will stop flashing after approximately one second and remain ON. This indicates that the unit is operating normally.

If the "Run" LED continues to flash, then this is indicative of a problem. In this case, use the Acromag IntelliPack Configuration Software to reconfigure the module or download its firmware and this will usually cure the problem. If the diagnostics continue to indicate a problem (a continuously flashing green LED), or if other evidence points to a problem with the unit, an effective and convenient fault diagnosis method is to exchange the questionable module with a known good unit.

The IntelliPack Serial Port Adapter also contains a red LED visible at the small opening in the enclosure to the right of the RJ11 receptacle. If this LED is OFF or Flashing and power is ON, then a communication interface problem exists. Note that the adapter receives its power from the IntelliPack module. A constant ON LED indicates a properly working and powered serial interface adapter.

Acromag's Application Engineers can provide further technical assistance if required. When needed, complete repair services are available from Acromag.

6.0 SPECIFICATIONS

895M-0800-C, One I/V Input, Single Open-Drain & SSR Output
896M-0800-C, Two I/V Inputs, Dual Open-Drain & SSR Outputs

General: The IntelliPack Model 895M-0800 and 896M-0800 are DC-powered computation transmitters which mathematically combine one or two channels of process current or voltage, and provide one or two isolated open drain frequency outputs whose response is the result of a programmed equation that operates on the input and output variables. A separate isolated control output is included for each input and may also have an equation defined for ON/OFF control of DC loads. Isolation is supplied between the input, frequency output, control outputs, and power. Input channels share common and are not isolated from each other. Frequency outputs also share common and are not isolated from each other. Control outputs are individually isolated. This transmitter is DIN-rail mounted.

The unit is configured and calibrated with our user-friendly Window 95/98® or NT® IntelliPack Configuration Program. All calibration and configuration information is stored in non-volatile reprogrammable memory in the module.

MODEL NUMBER DEFINITION

Transmitters are color coded with a white label. The prefix "8" denotes the IntelliPack Series 800, while the "M" suffix specifies that this device is primarily a computation (Math) transmitter.

89xM: Provides one or two channels of isolated open-drain output waveforms with variable duty cycle or frequency in response to mathematical equations that operate on the input and output variables. Additionally, it provides one or two solid-state control output(s) that are switched ON or OFF via the resultant of a programmed mathematical equation that operates on the input and output variables.

-0800: The four digits of this model suffix represent the following options, respectively:

0 = Relay: No Alarm Relay;
8 = Output: Frequency, Open-Drain;
0 = Enclosure: Standard DIN rail mount;
0 = Power: Standard DC power.

INPUT SPECIFICATIONS

Unit must be wired and configured for the intended input types and ranges (see Installation Section for details). The following paragraphs summarize this model's input types, ranges, and applicable specifications.

DC (Process) Current (Jumper Required): 0-1mA, 0-20mA, and 4-20mA. All input ranges are subsets of the 0-20mA input range. The input I+ terminal must be jumpered to the V+ terminal to utilize current input. A precision 49.9Ω current sink resistor is placed in the I+ input lead and converts the input current to a voltage that is processed by the A/D converter. The 0-1mA range is not recommended for dual-channel units (896M).
Current Input Reference Test Conditions: 4 to 20mA input (I+ to V+ jumper installed); Ambient Temperature = 25°C; Power Supply = 24VDC; Output = 0-10KHz; Output Formula = A (or D).
Input Overvoltage Protection: Bipolar Transient Voltage Suppressers (TVS), 18V clamp level typical.
Input Resistance: 550KΩ, typical.

DC Voltage (10:1 Input Divider): 0-5VDC or 0-10VDC.
Voltage Input Reference Test Conditions: 0 to 10V DC input; Ambient Temperature = 25°C; Power Supply = 24V DC; Output = 0-10KHz, Normal Acting; Output Formula = A (or D).
Input Overvoltage Protection: Bipolar Transient Voltage Suppressers (TVS), 18V clamp level typical.

General Input Specifications
Input Accuracy: Better than ±0.05% of input span, typical. Better than ±0.1%, typical for 0-1mA range (895M Only). The 0-1mA input range is not recommended for dual channel units (896M). This includes the effects of repeatability, but not sensor error. This refers to input accuracy only, but does not include frequency output accuracy (see Table 6).
Accuracy Versus Temperature: Better than ±0.005% of input span per °C, or ±1uV/°C, whichever is greater.
Resolution: See Table 5.
Input Bias Current: ±100nA maximum, excluding excitation current of process current inputs.
Input Filter: Normal mode filtering, plus digital filtering, optimized and fixed per input range within the Σ-Δ ADC.
Noise Rejection (Normal Mode): 40dB @ 60Hz, typical with 100Ω input unbalance (49.9Ω for process currents).
Noise Rejection (Common Mode): 100dB @ 60Hz, typical with 100Ω input unbalance (49.9Ω for process currents).
Analog to Digital Converter (A/D): A 16-bit Σ-Δ converter.
Input Conversion Rate: 896M at 8 conversions per second per channel typical; 895M at 15 conversions per second per channel typical. This rate will vary with the complexity of the configured computation.

Input Scaling: The configuration software is used to scale the nominal input signal range endpoints indicated, to values representative of the your application's engineering units. Constants are limited to 8 characters and may be entered as floating point numbers or using scientific notation. If you wish to use a subset of the nominal input range (note that these endpoints are fixed on the transmitter configuration page according to your input range selection), then you will have to extrapolate the corresponding scaled values as required.

Input Zero Dropout (Each Input): A zero dropout value from 0 to 10% of input span may be defined which sets the level below which the input is assumed to be zero. Resolution is 1% of nominal input span. Input values from 0 to this level are treated as equivalent to zero input. The input "STATUS" LED will blink if the input signal is below the zero dropout level. A zero dropout of 0% disables this feature. Zero dropout is useful for integral and totalization applications where some residual or base output must be ignored.

HLD1 & HLD2 (External Hold Input Terminals): A TTL or open collector/drain signal (5V logic) may be wired directly to the HLD1, HLD2, and HRTN terminals of the module to hold the corresponding transmitter's output at the last value while HOLD is asserted. HOLD is asserted low and pulled-up internally. The HOLD circuit is part of the input circuitry and is isolated from the output circuit. HOLD does not hold the engineering units computation, only the corresponding analog output. Note that the input return (RTN) and hold return (HRTN) terminals are not equivalent potentials and should never be tied together, either directly or through ground. Be careful when making earth ground connections that hold return (HRTN) is not tied to earth ground, which may be connected to input RTN.

Table 5: Effective Resolution Per Nominal Input Range

Gain A_V	Nominal Input Range	Effective Bits/ A/D Resolution
128	0-1mA DC	16797/ 60nA/LSB
8	0-20mA DC	20996/ 953nA/LSB
8	4-20mA DC	16797/ 953nA/LSB
2	0-5V DC	26298/ 190uV/LSB
1	0-10V DC	26298/ 380uV/LSB

OUTPUT SPECIFICATIONS

These units contain two types of outputs: an open-drain frequency output (1 per channel), plus an isolated control output (1 Form A switch per channel). Optically isolated micro-controllers provide the counter and timer functions for frequency output waveform control. Separately isolated solid-state relays provide control outputs. Frequency outputs share common and are not isolated output-to-output. Control outputs are individually isolated.

Frequency Output Specifications: These are open-drain frequency outputs whose duty-cycle or frequency is controlled via a pre-programmed control equation.

Output Configuration: Open-Drain Mosfet.
Output Maximum Drain Current: 1A maximum.
Output Maximum OFF-State Voltage: 60V DC.
Output Rds ON: 0.2Ω maximum, drain-to-source.
Output Frequency Range: 0-10KHz.
Output Pullup (Internal): 470Ω to circuit +5V in series with pullup terminals (PUL1 & PUL2). Install jumper from open-drain output (FRQ1 or FRQ2) to pullup terminals to use internal pullups. Otherwise, you may install a resistor from the open drain output (FRQ1 or FRQ2) to an external supply up to 60VDC.
Output Accuracy: See Table 6. Specification given does not apply to units calibrated for 0-1mA input range.
Output Resolution: Resolution varies with frequency. See Table 6.

Table 6: Effective Output Range Resolution & Accuracy

Output Range	Lowest Resolution	Accuracy (% Span)	
		Output	Overall
0 to 10KHz	10 Hz	0.1%	0.15%
0 to 1KHz	0.1 Hz	0.01%	0.06%
0 to 100Hz	0.008 Hz	0.008%	0.06%
0 to 10Hz	0.00064 Hz	0.0064%	0.06%
0 to 100000 CPH	10 CPH	0.01%	0.06%
0 to 10000 CPH	1.0 CPH	0.01%	0.06%
0 to 1000 CPH	0.1 CPH	0.01%	0.06%
0 to 100 CPH	0.01 CPH	0.01%	0.06%
0 to 10 CPH	0.001 CPH	0.01%	0.06%
0 to 100% Duty Cycle (Freq. 1Hz to 10KHz)	0.1%	0.1%	0.15%

Control Output Specifications: These are separately isolated control outputs (one switch per channel) that will change state according to a pre-programmed control equation.
Output Configuration: 1 Form A normally-open switch.
Output Maximum Current: 500mA DC maximum.
Output Maximum OFF-State Voltage: 60V DC.
Output ON-State Resistance: 0.7Ω maximum.
Output Response Time: 200ms typical, 65ms minimum.

General Output Specifications

Integral Non-Linearity: ±0.002% (±1.4LSB) of span typical, 0.012% (±7.9LSB) of span maximum, for ranges utilizing full output span.
Output Temperature Drift: Better than ±20ppm/°C Typical, ±50ppm/°C Maximum.
Output Conversion Rate: 896M at 8 conversions per second per channel typical; 895M at 15 conversions per second per channel typical. This rate will vary with the complexity of the configured computation.
Output HOLD Function: A TTL or open collector/drain signal (5V logic) may be wired directly to the HLD1, HLD2, and HRTN terminals of the module to hold the transmitter's corresponding output at the last value. HOLD is asserted low and pulled-up internally. HOLD does not hold the engineering units computation, only the corresponding analog output. The HOLD circuit is part of the input circuit and isolated from the output circuit. Note that input return (RTN) and hold return (HRTN) are not equivalent potentials and should never be tied together, either directly or through ground.

Be careful when making earth ground connections that hold return (HRTN) is not tied to earth ground, which may be connected to input RTN.

Output Scaling: The configuration software is used to scale the output signal range endpoints (in Hz, CPH, or % Duty Cycle), to values representative of your output equation's engineering units. Output frequency is limited from 0 to 10Hz (minimum span) to 0 to 10KHz (maximum span), or 0 to 10CPH (minimum span) to 0 to 100000CPH (maximum span). Output duty cycle is 0% to 100% for frequencies from 1Hz to 10KHz. Constants are limited to 8 characters and may be entered as floating point numbers or using scientific notation.

ENCLOSURE/PHYSICAL SPECIFICATIONS

Unit is packaged in a general purpose plastic enclosure that is DIN rail mountable for flexible, high density (approximately 1" wide per unit) mounting. See Enclosure Dimensions Drawing 4501-642 for details.

Dimensions: Width = 1.05 inches, Height = 4.68 inches, Depth = 4.35 inches (see Drawing 4501-745).
DIN Rail Mounting (-xx0x): DIN rail mount, Type EN50022; "T" rail (35mm).
Connectors: Removable plug-in type terminal blocks; Current/Voltage Ratings: 15A/300V; Wire Range: AWG #14-24 solid or stranded; separate terminal blocks are provided for inputs 1 & 2, solid state relay outputs 1 & 2, power & HOLD terminals, and frequency outputs 1 & 2.
Case Material: Self-extinguishing NYLON type 6.6 polyamide thermoplastic, UL94 V-2, color beige; general purpose NEMA Type 1 enclosure.
Printed Circuit Boards: Military grade FR-4 epoxy glass.
Shipping Weight: 1 pound (0.45 Kg) packed.

APPROVALS (-xxx0)

0: cULus Listed, UL File E199702

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature: -25°C to +70°C (-13°F to +158°F).
Storage Temperature: -40°C to +85°C (-40°F to +185°F).
Relative Humidity: 5 to 95%, non-condensing.
Power Requirements: +10V Minimum to +36V DC Maximum. Current draw is a function of supply voltage (see Table 8). Current draw is given with and without the Serial Port Adapter connected for single and dual channel models, with status LED's ON. An internal diode provides reverse polarity protection. Your power supply must be adequate to provide the steady-state current shown below, plus the peak inrush current that occurs when power is switched on. As a general rule, your supply should be chosen to provide at least twice the current indicated below for the voltage of interest, or startup problems may occur.

> **CAUTION:** Do not exceed 36VDC peak, to avoid damage to the module.

Table 8A: 896M Supply Current

Supply Voltage	Supply Current (SPA Connected)	Supply Current (SPA Not Connected)
10V	130mA	105mA
12V	105mA	85mA
15V	85mA	70mA
24V	55mA	50mA
36V	45mA	40mA

Table 8B: 895M Supply Current

Supply Voltage	Supply Current (SPA Connected)	Supply Current (SPA Not Connected)
10V	120mA	95mA
12V	95mA	80mA
15V	80mA	65mA
24V	50mA	45mA
36V	40mA	35mA

IMPORTANT - External Fuse: If unit is powered from a supply capable of delivering more than 1A to the unit, it is recommended that this current be limited via a high surge tolerant fuse rated for a maximum current of 1A or less (for example, see Bel Fuse MJS1).

Power Supply Effect:
DC Volts: Less than ±0.001% of output span change per +volt DC for rated power supply variations.
60/120 Hz Ripple: Less than 0.01% of output span per volt peak-to-peak of power supply ripple.
Isolation: Input, frequency output, control outputs, and power circuits are isolated from each other for common-mode voltages up to 250VAC, or 354V DC off DC power ground, on a continuous basis (will withstand 1500VAC dielectric strength test for one minute without breakdown). This complies with test requirements outlined in ANSI/ISA-82.01-1988 for the voltage rating specified. Inputs share common and are not isolated from each other. Outputs also share common and are not isolated output-to-output. Control outputs are separately isolated.
Installation Category: Designed to operate in an Installation Category (Overvoltage Category) II environment per IEC 1010-1 (1990).
Radiated Field Immunity (RFI): Designed to comply with IEC1000-4-3 Level 3 (10V/M, 80 to 1000MHz AM & 900MHz keyed) and European Norm EN50082-1.
Electromagnetic Interference Immunity (EMI): No output shift will occur beyond ±0.25% of span, under influence of EMI from switching solenoids, commutator motors, & drill motors.
Electrical Fast Transient Immunity (EFT): Complies with IEC1000-4-4 Level 3 (2KV power; 1KV signal lines) and European Norm EN50082-1.
Electrostatic Discharge (ESD) Immunity: Complies with IEC1000-4-2 Level 3 (8KV/4KV air/direct discharge) to the enclosure port and European Norm EN50082-1.
Surge Immunity: Complies with IEC1000-4-5 Level 3 (2.0KV) and European Norm EN50082-1.
Radiated Emissions: Meets or exceeds European Norm EN50081-1 for class A equipment.

STATUS INDICATORS

Run (Green) - Constant ON indicates power is applied and unit is operating normally. Flashing ON/OFF indicates that unit is performing diagnostics (first second following power-up), or has failed diagnostics (after a few seconds).
Status (Yellow, Each Channel) - Constant ON if input is outside of the built-in over-range limit of ±10%. Flashes ON/OFF if input at or below a specified non-zero dropout level (setting zero dropout to 0.0% disables zero dropout detection). OFF for normal operating conditions.
Control (Yellow, Each Channel) - ON if corresponding control output switch is closed, OFF if switch is open.

HOST COMPUTER COMMUNICATION

Host Communication Port (SPI): IntelliPack SPI port (standard RJ11 6-wire phone jack). See Drawing 4501-721 for location. Configuration information is downloaded from the host computer through one of its EIA232 serial ports. This port must be connected to the module through an Acromag IntelliPack Serial Port Adapter. This Serial Port Adapter serves as an isolated interface converter between EIA232 and the IntelliPack's SPI port.
Baud Rate (EIA232): 19.2K baud.

SOFTWARE CONFIGURATION

Units are fully reprogrammable via our user-friendly Windows 95/98® or NT® IntelliPack Configuration Program (Model 5030-881). Programmable attributes for this model are given below. A cable (5030-902) and converter (5030-913) are required to complete the interface (Software Interface Package 800C-SIP). See Drawing 4501-643. Additional information can be found in the IntelliPack Transmitter Configuration Manual (8500-570).

Input Configuration
Input - Range (Each Input): The transmitter can be configured to accept any one of the five input range types shown below. However, a short jumper wire must be installed between the input "I+" and "V+" terminals to utilize current input ranges. Input range volts and milliamperes can be scaled to engineering units per your application (see Transmitter Configuration).
Voltage: 0 to 10V DC, 0 to 5V DC.
Current (Jumper Required): 0-20mA, 4-20mA, or 0-1mA DC. The 0-1mA range is not recommended for 896M units.
Input - ZDO (Zero Dropout, Each Input): Enter a zero dropout value from 0% to 10% of input span to define the level below which the input is assumed to be zero. Resolution is 1% of nominal input span. Input values from 0 to this level are treated as equivalent to zero input. The input "STATUS" LED will blink if the input signal is at or below the zero dropout level. Setting this to 0% disables this feature. Zero dropout is useful for integral and totalization applications where some residual or base output level must be ignored.
Input - ID (Optional, Each Input): Enter up to 15 alphanumeric characters relative to the identity of the input.
Visual Input Over/Under Range Indicator (Each Input): A yellow status LED for each channel (labeled "STATUS") is constant ON if the input signal is over or under range.
Visual Zero Drop Out Indicator (Each Input): A yellow status LED for each channel (labeled "STATUS") flashes if the input signal is at or below the zero dropout level specified.

Output Configuration
Output - Range: Select one of three output range types as described below:
Frequency (Hertz): In this mode, a square wave with a 50% duty cycle is generated and its frequency is varied via the output equation in the range of 0 to 10Hz (full-scale) to 0Hz to 10000Hz (full-scale).
Frequency Counts Per Hour (CPH): In this mode, a pulse train from 0 to 10CPH (full-scale) to 0 to 100000CPH (full-scale) is generated via the output equation. A minimum pulse width from 0-255ms, as appropriate to frequency, must also be specified (see On-Time below). Note that the maximum frequency in counts per hour is limited to 3600 multiplied by the reciprocal of twice the on-time selected.
Duty-Cycle (%On): In this mode, a fundamental square wave frequency is specified from 1Hz to 10KHz and the pulse width (ON-time) of the resultant output waveform is modulated from 0% to 100% via the output equation.
Output - On Time (Milliseconds, Frequency CPH Only): If the Frequency Counts Per Hour Output Range is selected, then a pulse-width on-time must be specified from 0-255ms (accuracy is +0ms, -1ms). A default output ON pulse-width of 50ms is assumed. An on time of 0ms will output a pulse with a 50% duty cycle. Note that the maximum frequency in counts per hour is limited to 3600 multiplied by the reciprocal of twice the on-time selected.
Output - Frequency (Hertz, Frequency Duty-Cycle %On Only): If the Frequency Duty Cycle Output Range is selected, then a fixed frequency of 1 to 10000Hz must be specified. The duty cycle of the pulse generated at this frequency will vary with the input signal according.

Transmitter Configuration

Note: Refer to the examples given in the IntelliPack Configuration Software HELP file for additional information.

Transmitter - Scaling (Each Input, Each Output): Scaled values must be entered for each input and output to translate the nominal zero and full-scale input and output range endpoints, to the engineering units required by your application. Additionally, initial output values must be specified and take effect following power-up or a reset until the internal calculation takes control of the output. A subset of the output range may be used by changing the output zero and full-scale signal values, but if you wish to use a subset of the selected input range, you will have to extrapolate your engineering unit values to the nominal input range endpoints indicated, as the input zero and full-scale values are fixed per the selected input range. Up to 8 characters may be used to specify constants and scientific notation is supported. Up to 6 characters may be used to describe the engineering units of the scaled input and output values. For example, a 4-20mA input signal range may be scaled to 0 to 5000 GPM. Note that an equation only operates on the equivalent scaled input values. The computed output value in engineering units is then scaled to the nominal zero and full-scale output range endpoint values (frequency or pulse-width) for the particular output range selected. The scaling parameters are defined as follows:

Zero Engineering Units Value (Inputs and Outputs): The zero engineering units value is the scaled input or output value in engineering units that is to correspond to the zero input signal value or zero output signal value.

Zero Signal Value (Inputs and Outputs): The zero signal value is the input or output signal value in input or output units that is to correspond to the input or output zero engineering units value. Only the output zero signal value can be modified, while the input zero signal value is fixed at the minimum input range endpoint.

Full-Scale Engineering Units Value (Inputs and Outputs): The full-scale engineering units value is the scaled input or output value in engineering units that is to correspond to the full-scale input signal value or full-scale output signal value.

Full-Scale Signal Value (Inputs and Outputs): The full-scale signal value is the input or output signal value in input or output units that is to correspond to the input or output full-scale engineering units value. Only the output full-scale signal value can be modified, while the input full-scale signal value is fixed at the maximum input range endpoint.

Engineering Units (Inputs and Outputs): A text string of up to 6 alphanumeric characters that denotes the engineering units of the scaled input and output values.

Initial Engineering Units Value (Outputs Only): This is the initial output value that is assumed upon power-up or following a reset and remains in effect until replaced by the internally calculated value. For the control outputs, any non-zero value is true and will turn the corresponding switch ON.

Transmitter - Equation (Each Output, Each Control Output): Up to 200 characters may be used to specify an output equation that is the mathematical combination of the input(s), output(s), or control output(s). A free-form equation is entered in “in-fix” notation that uses floating-point constants, scaled input channel variables, standard operators, functions, logical operators, and conditional constructs (see Table 3). Constants are single precision floating-point values (scientific notation supported) and are limited to 8 characters. The computed output is then scaled to output range endpoints of frequency (Hertz or Counts Per Hour) or pulse width (%On Time), according to your selected output range type. Equation variables A, B, C, D, E, and F are used to represent the scaled values of input 1, output 1, control output 1, input 2, output 2, and control output 2, respectively.

Transmitter - Show Simulator: The Show Simulator function is used to test your equation and ensure that a correct output response within range is produced, without having to drive the inputs with real world signals. Slide controls are provided to vary simulated input signals (click and drag with your mouse). Fine control of the slide controls is also possible via your arrow keys. Equations for both outputs and both control outputs may also be modified to test their effect on the simulated variables. Error checking in this area is limited and it is up to the user to verify correct formulation for all possible conditions of input and output. As such, use of the Show Simulator function is highly recommended for critical control applications.

Visual Control Output Indicator (Each Control Output): A yellow LED for each control output provides visual status indication of when the corresponding output switch is conducting (LED is ON if switch is closed).

Input Calibration

Input Calibration - Low (Each Input): This value is the low endpoint or zero of the configured input range and must precisely match the applied input signal level upon calibration. To calibrate, adjust your input signal to precisely match the Low Calibration Value field entry, then press the Low **“Calibrate”** button to set the Low Calibration Value. Restrict your adjustment of the Low Calibration Value to roughly ±10% of span from the nominal low range endpoint.

Input Calibration - High (Each Input): This value is the high endpoint or full-scale value of the configured input range and must precisely match the applied input signal level upon calibration. To calibrate, adjust your input signal to precisely match the High Calibration Value field entry, then press the High **“Calibrate”** button to set the High Calibration Value. Restrict your adjustment of the High Calibration Value to roughly ±10% of span from the nominal full-scale range endpoint. For best results, you should always calibrate the low value first before the high value.

Input Calibration - Restore Factory Calibration (Each Input): The IntelliPack Configuration Software provides this control to restore a module’s original factory calibration for the configured input range in the event that miscalibration has occurred.

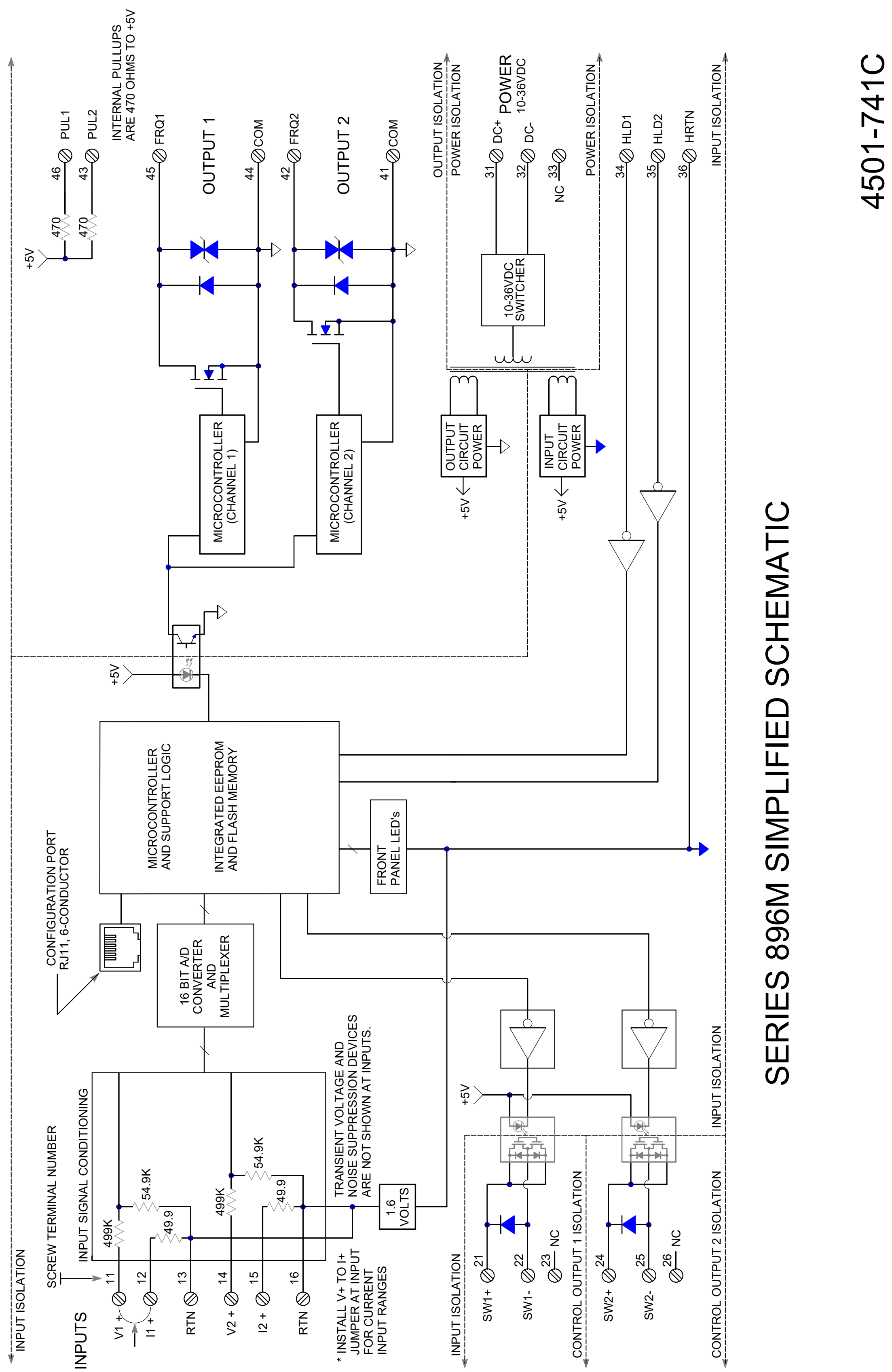
Input Calibration (Each Input, Each Range): The IntelliPack Configuration Software can be used to calibrate available input ranges at each input channel of this module. In addition, the original factory calibration may optionally be restored in the event of miscalibration.

Summary Of IntelliPack Configuration Software Capabilities

In addition to configuring all features of the module described above, the IntelliPack Configuration Software includes additional capabilities for testing and control of the module as follows:

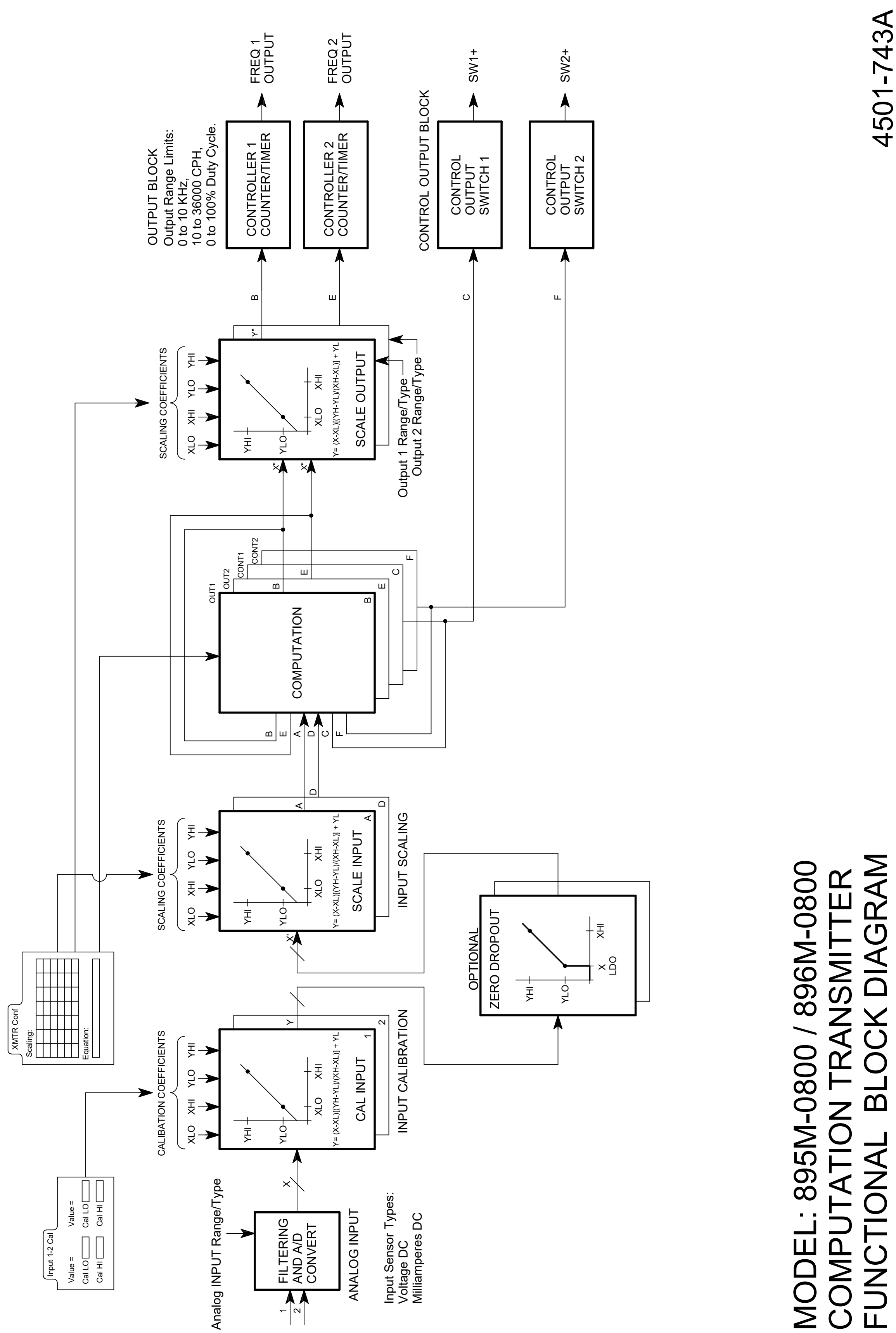
- Monitors the input and output signal values and allows polling to be turned on or off.
- Provides a “Show Simulator” function to simulate input variations and test the programmed equation.
- Allows a configuration to be uploaded or downloaded to/from the module. Also provides a means to rewrite a module’s firmware if the microcontroller is replaced or a module’s functionality is updated.
- Provides controls to separately calibrate the inputs and restore the original factory input or output calibration in case of error.
- Provides a control to reset a module.
- Provides a control to adjust a transmitter’s output signal independent of the input signals (includes timed override).
- Allows optional user documentation information to be written to the module. Documentation fields are provided for tag number, comment, configured by, location, and identification information. This information can also be uploaded from the module and printed via this software.
- Allows a module’s complete configuration to be printed in an easy to read, two-page form, including user documentation.
- Includes on-line help and context (field) sensitive help functions.

For additional information on the IntelliPack Configuration Software, refer to the Transmitter Configuration Manual 8500-570.

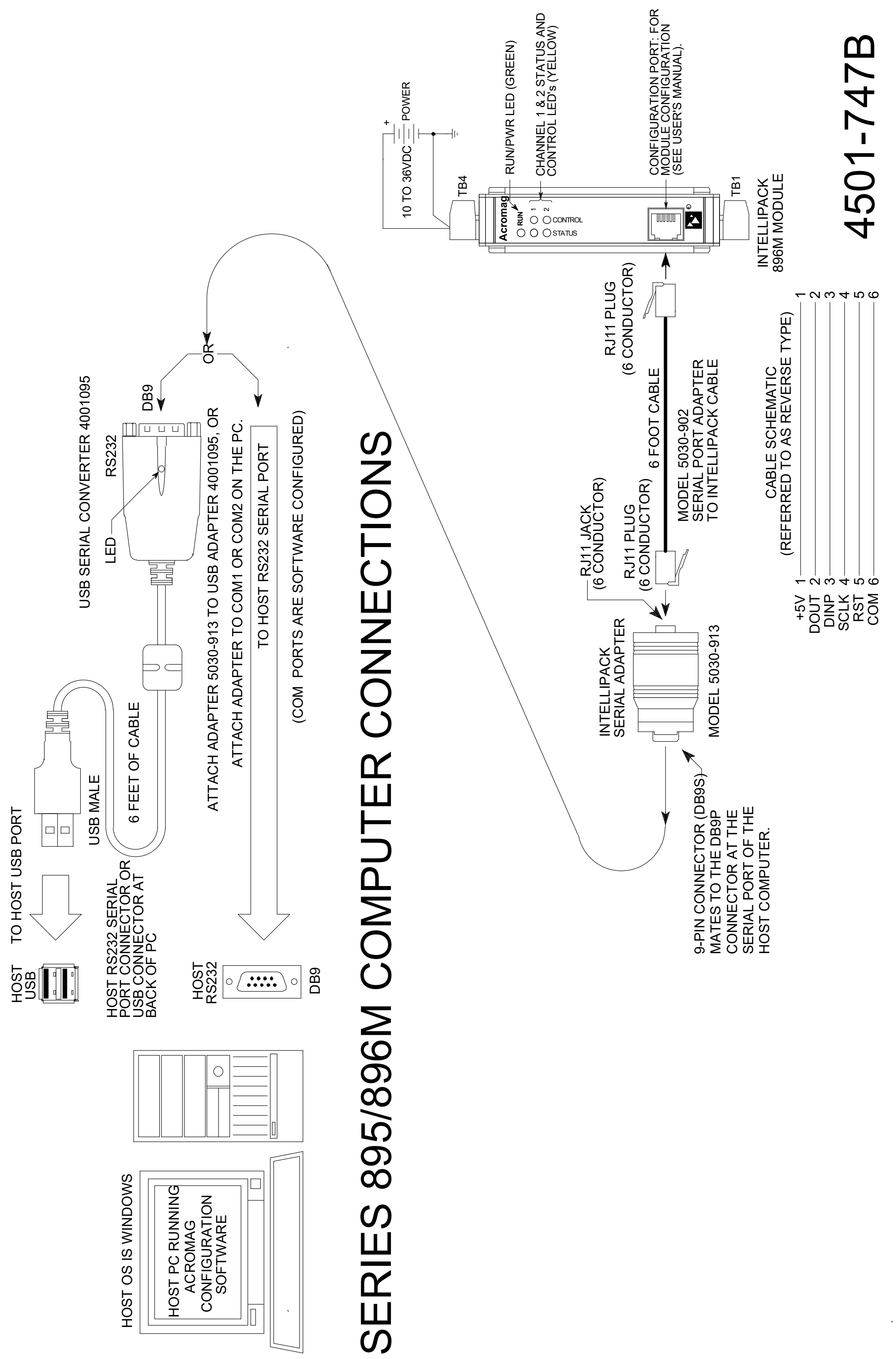


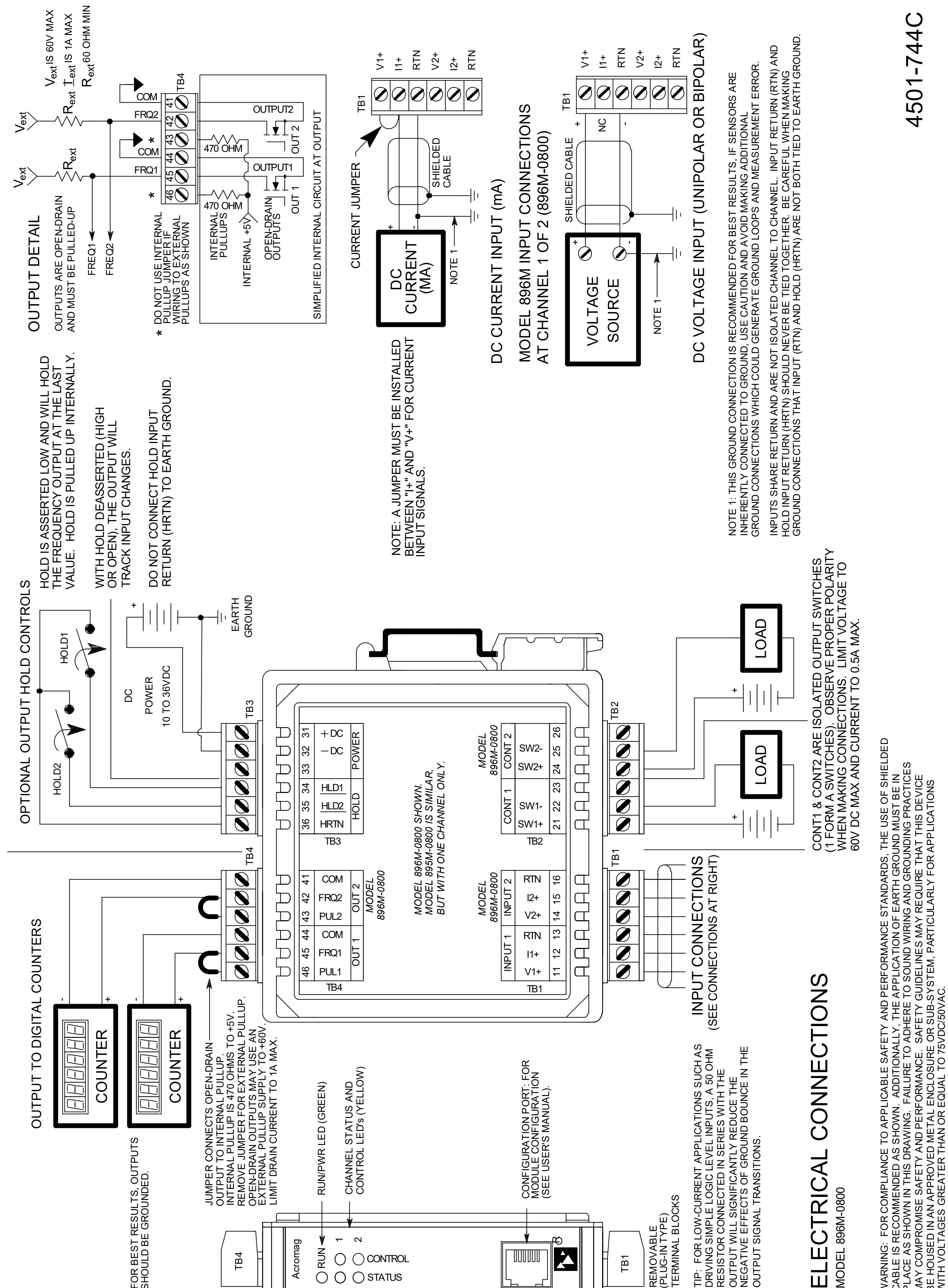
SERIES 896M SIMPLIFIED SCHEMATIC

4501-741C

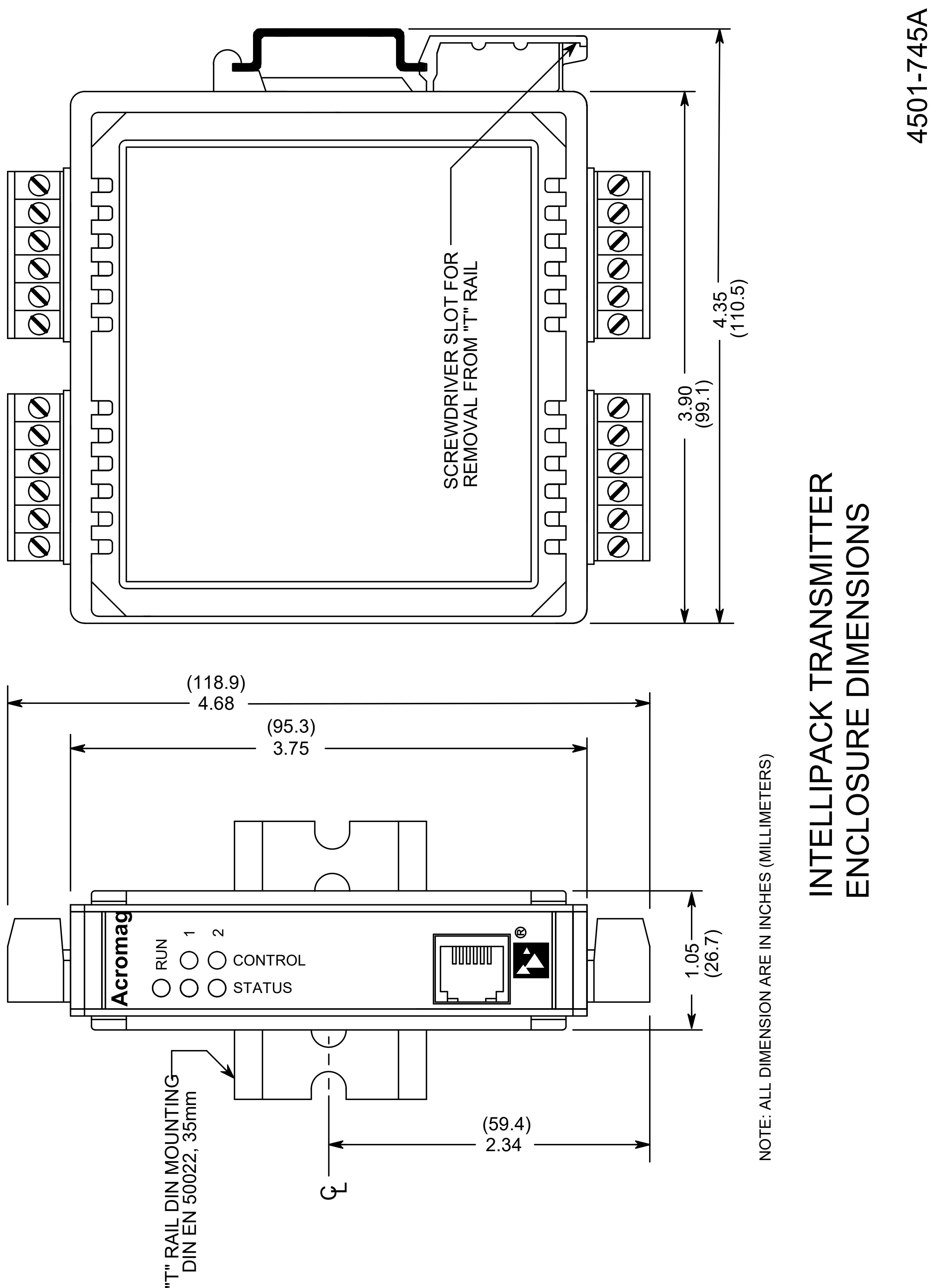


MODEL: 895M-0800 / 896M-0800
COMPUTATION TRANSMITTER
FUNCTIONAL BLOCK DIAGRAM
4501-743A
Analog INPUT Range/Type
FILTERING AND A/D CONVERT
ANALOG INPUT
Input Sensor Types:
Voltage DC
Milliamperes DC
Input 1-2 Cal
Value =
Cal LO
Cal HI
CALIBRATION COEFFICIENTS
XLO XHI YLO YHI
CAL INPUT
INPUT CALIBRATION
Y= (X-XL)[(YH-YL)/(XH-XL)] + YL
XMTR Conf
Scaling:
Equation:
SCALING COEFFICIENTS
SCALE INPUT
INPUT SCALING
OPTIONAL
ZERO DROPOUT
LDO
COMPUTATION
OUT1
OUT2
CONT1
CONT2
SCALE OUTPUT
Output 1 Range/Type
Output 2 Range/Type
OUTPUT BLOCK
Output Range Limits:
0 to 10 KHz,
10 to 36000 CPH,
0 to 100% Duty Cycle.
CONTROLLER 1 COUNTER/TIMER
CONTROLLER 2 COUNTER/TIMER
FREQ 1 OUTPUT
FREQ 2 OUTPUT
CONTROL OUTPUT BLOCK
CONTROL OUTPUT SWITCH 1
CONTROL OUTPUT SWITCH 2
SW1+
SW2+


SERIES 895/896M COMPUTER CONNECTIONS
4501-747B
HOST OS IS WINDOWS
HOST PC RUNNING ACROMAG CONFIGURATION SOFTWARE
HOST USB
TO HOST USB PORT
HOST RS232 SERIAL PORT CONNECTOR OR USB CONNECTOR AT BACK OF PC
HOST RS232
DB9
USB MALE
6 FEET OF CABLE
USB SERIAL CONVERTER 4001095
LED
RS232
DB9
OR
ATTACH ADAPTER 5030-913 TO USB ADAPTER 4001095, OR
ATTACH ADAPTER TO COM1 OR COM2 ON THE PC.
TO HOST RS232 SERIAL PORT
(COM PORTS ARE SOFTWARE CONFIGURED)
INTELLIPACK SERIAL ADAPTER
MODEL 5030-913
9-PIN CONNECTOR (DB9S) MATES TO THE DB9P CONNECTOR AT THE SERIAL PORT OF THE HOST COMPUTER.
RJ11 JACK (6 CONDUCTOR)
RJ11 PLUG (6 CONDUCTOR)
6 FOOT CABLE
MODEL 5030-902 SERIAL PORT ADAPTER TO INTELLIPACK CABLE
RJ11 PLUG (6 CONDUCTOR)
CABLE SCHEMATIC (REFERRED TO AS REVERSE TYPE)
+5V 1
DOUT 2
DINP 3
SCLK 4
RST 5
COM 6
1
2
3
4
5
6
10 TO 36VDC
POWER
TB4
RUN/PWR LED (GREEN)
CHANNEL 1 & 2 STATUS AND CONTROL LED's (YELLOW)
Acromag
RUN
CONTROL
STATUS
CONFIGURATION PORT: FOR MODULE CONFIGURATION (SEE USER'S MANUAL).
TB1
INTELLIPACK 896M MODULE



ELECTRICAL CONNECTIONS
MODEL 896M-0800
4501-744C
OUTPUT TO DIGITAL COUNTERS
COUNTER
COUNTER
FOR BEST RESULTS, OUTPUTS SHOULD BE GROUNDED.
JUMPER CONNECTS OPEN-DRAIN OUTPUT TO INTERNAL PULLUP. INTERNAL PULLUP IS 470 OHMS TO +5V. REMOVE JUMPER FOR EXTERNAL PULLUP. OPEN-DRAIN OUTPUTS MAY USE AN EXTERNAL PULLUP SUPPLY TO +60V. LIMIT DRAIN CURRENT TO 1A MAX.
RUN/PWR LED (GREEN)
CHANNEL STATUS AND CONTROL LED's (YELLOW)
CONFIGURATION PORT: FOR MODULE CONFIGURATION (SEE USER'S MANUAL).
REMOVABLE (PLUG-IN TYPE) TERMINAL BLOCKS
Acromag
RUN
CONTROL
STATUS
TB4
TB1
TIP: FOR LOW-CURRENT APPLICATIONS SUCH AS DRIVING SIMPLE LOGIC LEVEL INPUTS, A 50 OHM RESISTOR CONNECTED IN SERIES WITH THE OUTPUT WILL SIGNIFICANTLY REDUCE THE NEGATIVE EFFECTS OF GROUND BOUNCE IN THE OUTPUT SIGNAL TRANSITIONS.
WARNING: FOR COMPLIANCE TO APPLICABLE SAFETY AND PERFORMANCE STANDARDS, THE USE OF SHIELDED CABLE IS RECOMMENDED AS SHOWN. ADDITIONALLY, THE APPLICATION OF EARTH GROUND MUST BE IN PLACE AS SHOWN IN THIS DRAWING. FAILURE TO ADHERE TO SOUND WIRING AND GROUNDING PRACTICES MAY COMPROMISE SAFETY AND PERFORMANCE. SAFETY GUIDELINES MAY REQUIRE THAT THIS DEVICE BE HOUSED IN AN APPROVED METAL ENCLOSURE OR SUB-SYSTEM, PARTICULARLY FOR APPLICATIONS WITH VOLTAGES GREATER THAN OR EQUAL TO 75VDC/50VAC.
OPTIONAL OUTPUT HOLD CONTROLS
HOLD2
HOLD1
DC POWER 10 TO 36VDC
EARTH GROUND
TB3
TB2
MODEL 896M-0800 SHOWN. MODEL 895M-0800 IS SIMILAR, BUT WITH ONE CHANNEL ONLY.
INPUT CONNECTIONS (SEE CONNECTIONS AT RIGHT)
CONT1 & CONT2 ARE ISOLATED OUTPUT SWITCHES (1 FORM A SWITCHES). OBSERVE PROPER POLARITY WHEN MAKING CONNECTIONS. LIMIT VOLTAGE TO 60V DC MAX AND CURRENT TO 0.5A MAX.
LOAD
LOAD
HOLD IS ASSERTED LOW AND WILL HOLD THE FREQUENCY OUTPUT AT THE LAST VALUE. HOLD IS PULLED UP INTERNALLY.
WITH HOLD DEASSERTED (HIGH OR OPEN), THE OUTPUT WILL TRACK INPUT CHANGES.
DO NOT CONNECT HOLD INPUT RETURN (HRTN) TO EARTH GROUND.
NOTE: A JUMPER MUST BE INSTALLED BETWEEN "I+" AND "V+" FOR CURRENT INPUT SIGNALS.
NOTE 1: THIS GROUND CONNECTION IS RECOMMENDED FOR BEST RESULTS. IF SENSORS ARE INHERENTLY CONNECTED TO GROUND, USE CAUTION AND AVOID MAKING ADDITIONAL GROUND CONNECTIONS WHICH COULD GENERATE GROUND LOOPS AND MEASUREMENT ERROR.
INPUTS SHARE RETURN AND ARE NOT ISOLATED CHANNEL TO CHANNEL. INPUT RETURN (RTN) AND HOLD INPUT RETURN (HRTN) SHOULD NEVER BE TIED TOGETHER. BE CAREFUL WHEN MAKING GROUND CONNECTIONS THAT INPUT (RTN) AND HOLD (HRTN) ARE NOT BOTH TIED TO EARTH GROUND.
OUTPUT DETAIL
OUTPUTS ARE OPEN-DRAIN AND MUST BE PULLED-UP
Vext IS 60V MAX
Iext IS 1A MAX
Rext 60 OHM MIN
DO NOT USE INTERNAL PULLUP JUMPER IF WIRING TO EXTERNAL PULLUPS AS SHOWN
INTERNAL PULLUPS
INTERNAL +5V
OPEN-DRAIN OUTPUTS
470 OHM
OUTPUT1
OUTPUT2
SIMPLIFIED INTERNAL CIRCUIT AT OUTPUT
CURRENT JUMPER
SHIELDED CABLE
DC CURRENT (MA)
NOTE 1
DC CURRENT INPUT (mA)
MODEL 896M INPUT CONNECTIONS AT CHANNEL 1 OF 2 (896M-0800)
VOLTAGE SOURCE
DC VOLTAGE INPUT (UNIPOLAR OR BIPOLAR)


4501-745A
SCREWDRIVER SLOT FOR
REMOVAL FROM "T" RAIL
3.90
(99.1)
4.35
(110.5)
(118.9)
4.68
(95.3)
3.75
Acromag
RUN
1
2
CONTROL
STATUS
1.05
(26.7)
"T" RAIL DIN MOUNTING
DIN EN 50022, 35mm
(59.4)
2.34
NOTE: ALL DIMENSION ARE IN INCHES (MILLIMETERS)
INTELLIPACK TRANSMITTER
ENCLOSURE DIMENSIONS

Acromag® THE LEADER IN INDUSTRIAL I/O

30765 S. Wixom Road • P.O. Box 437 • Wixom, MI • 48393-7037 USA

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FACTORY CONFIGURATION ORDER FORM

Model:	[ ] 895M-0800	[ ] 896M-0800
Quantity:		
PO Number:		
Customer:		
Signature:		

General *MODELS 895M-0800 & 896M-0800*

Module *Limit fields to number of characters shown*

Tag : [ ]

Comment: [ ]
[ ]

Config. By: [ ]

Location: [ ]
[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Input Configuration *896M-0800 Only*

Input 1 Range	**Input 2 Range**
[ ] 0-5V DC	[ ] 0-5V DC
[ ] 0-10V DC	[ ] 0-10V DC
[ ] 0-1mA DC	[ ] 0-1mA DC
[ ] 0-20mA DC	[ ] 0-20mA DC
[ ] 4-20mA DC	[ ] 4-20mA DC
ZDO (Zero Drop Out %)	**ZDO (Zero Drop Out %)**
[ ]0 [ ]1 [ ]2 [ ]3 [ ]4 [ ]5	[ ]0 [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
[ ]6 [ ]7 [ ]8 [ ]9 [ ]10	[ ]6 [ ]7 [ ]8 [ ]9 [ ]10

Install jumper between Input "I+" and "V+" for current input.

Input 1 ID ____________________

Input 2 ID ____________________

Output Configuration *896M-0800 Only*

Output 1 Range	**Output 2 Range**
[ ] Frequency (Hz)	[ ] Frequency (Hz)
[ ] Frequency (CPH)	[ ] Frequency (CPH)
➥ On Time ____ ms	➥ On Time ____ ms
[ ] Duty Cycle (% On)	[ ] Duty Cycle (% On)
➥ Frequency ____ Hz	➥ Frequency ____ Hz

Notes:

Xmtr Config *For scaling, use floating-point values up to 8 characters. Large numbers may use scientific notation.*

I/O (Symbol)	Zero Signal Value	Zero Engr Units Value	Full-Scale Signal Value	Full-Scale Eng Units *(8 Characters Max)*	Initial EU Value	Eng Units *(6 Char)*
Input 1 (A)	*Set Per Range*		*Set Per Range*			
Output 1 (B)						
Control 1 (C)	*Open*	0	*Closed*	<>0		
Input 2 (D)	*Set Per Range*		*Set Per Range*			
Output 2 (E)						
Control 2 (F)	*Open*	0	*Closed*	<>0		

Output Equations

*Up to 200 characters may be used to define the output equation. Use A, B, C, D, E, F for scaled input 1, output 1, control 1, input 2, output 2, control 2, respectively. Use operators +. -, *, /, parenthesis ( ), & functions MIN(n1,...,n5), MAX(n1,...,n5), SQRT(n1), ABS(n1), EXP(n1), LN(n1), LOG10(n1), POWER(n1,n2), SIN(n1), COS(n1), TAN(n1), ASIN(n1), ACOS(n1), and ATAN(n1). You may also use IF(condition) THEN(n1) ELSE(n2) with AND(n1,...,n5), OR(n1,...,n5), >, >=, <, <=, =, <>.*

Output 1 (B) =

Control 1 (C) =

Output 2 (E) = *(896M-0800)*

Control 2 (F) = *(896M-0800)*

Revision History

The following table details the revision history for this document:

Release Date	Version	EGR/DOC	Description of Revision
3-AUG-2017	F	CAP/JAA	Remove CE Mark due to non-RoHS compliant part. Refer to ECO# 17G016.