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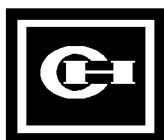
INSTALLATION AND OPERATION
MANUAL Number 58840-900-08

MODEL 5884-0400 and MODEL 5884-1400
DUAL PRESET 6 DIGIT ELECTRONIC CONTROL



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Printed in U.S.A.

GENERAL DESCRIPTION

The Durant Model 5884 is a versatile, six-digit, dual preset, bi-directional count control with both relay and transistor outputs. The control functions either as a "Reset to Preset" control with outputs occurring when the count reaches zero or a preset, or as a "Reset to Zero" control with outputs occurring when the count is equal to one or the other of the two preset numbers.

The 5884 also provides a second internal counter called the Totalizer. The Totalizer can be used as a Batch Totalizer to count how many cycles the 5884 has performed. Additionally, a Batch Preset may be set up to allow control of Batch quantities. A third output is provided for Batch control.

The 5884-1400 Model also features the ability to scale incoming counts. This means that for each pulse received on the count inputs, a fraction or multiple of that pulse is indicated on the display. Scaling is useful to make conversions between different units of measure (inches to centimeters, for example) or to totalize parts produced from multiple part manufacturing processes (such as six parts produced for each operation of a press).

The scale factor can be a number from 0.0001 to 9.9999. This number becomes a factor by which incoming count pulses are multiplied. The result of the multiplication is shown on the front panel display.

A non-volatile memory insures that the setup instructions will not be lost if power is interrupted. Count and Batch values will also be retained if a power loss interrupts a process or machine cycle.

The front panel of the control, Figure 1, is framed by a bezel that seals the panel to the mounting surface. A large, six-digit high visibility red LED display with a programmable decimal point position is located in the upper left portion of the panel. The keyboard has a Polycarbonate Lexan front face and consists of ten data keys (0 through 9), "COUNT" key, "RESET" key, "FUNCTION" key and "ENTER" key. The "1" data key also serves as the "PRESET 1" key and the "2" key also serves as the "PRESET 2" key. The "6" data key serves as the "BATCH PRESET" key and the "7" data key as the "BATCH COUNT" key. The upper right portion of the front panel contains four yellow LED indicators for Count, Preset 1, Preset 2 and Batch operation.

The rear panel, Figure 2, contains screw terminals for use with stripped wire, either solid or stranded, from 28 to 14 gauge. The rear panel also contains two plug-in type replaceable relays, with "form-C" contacts.

Through use of two stripped and tinned leads provided at the center of the rear panel, the two relays can be operated by any combination of Output 1, Output 2 or the Batch Output. The user simply

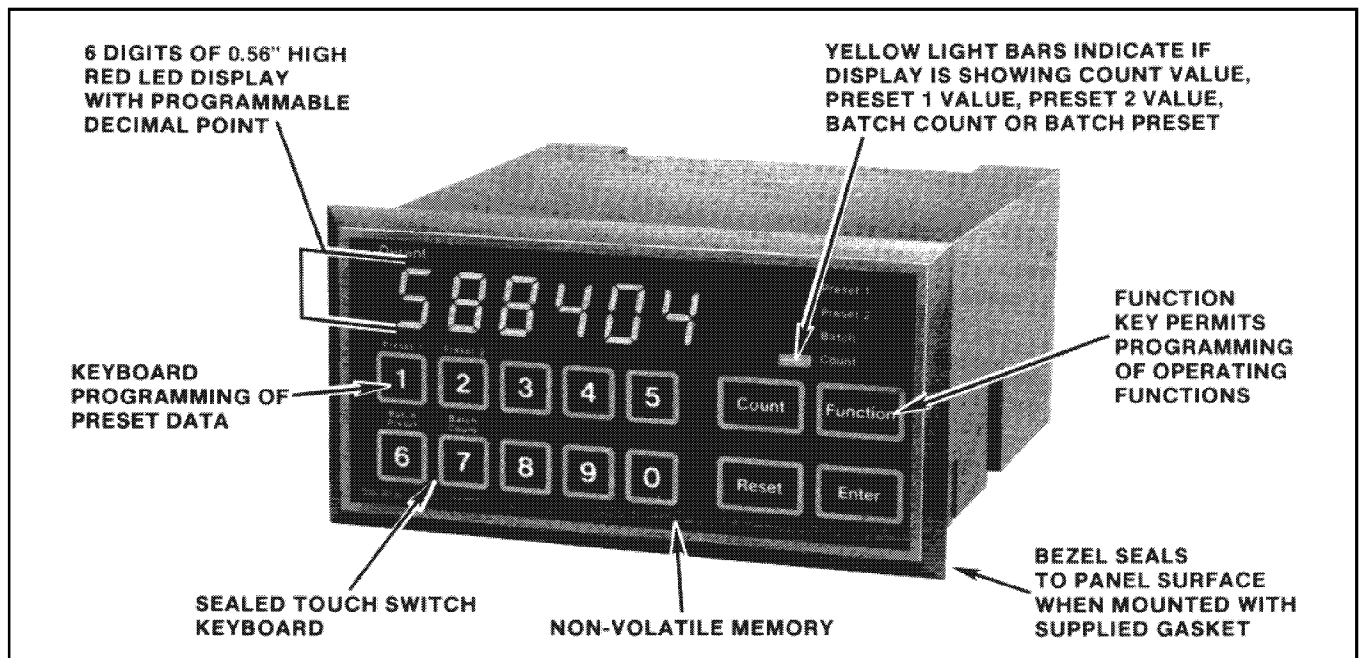


Figure 1. 5884 Dual Preset 6-Digit Electronic Control



The 5884 includes a “Crop-cut” input which allows any combination of outputs to be energized. The user selects which output(s) will be energized, providing the capacity for synchronizing the counter with the process, taking an inspection sample and/or removing a defective part without incrementing the batch counter. The counter may be optionally reset via the Crop Input.

The relay and transistor outputs can be timed from 0.01 to 99.99 seconds inclusive, latched until reset

The count input circuit provides the user with several options:

- The control is equipped with self-diagnostics which test the internal memories for faults. Should a fault be detected, an indication is given on the display. Displays and indicators are turned on in a patterned sequence for visual examination.

SPECIFICATIONS

POWER REQUIREMENTS:

AC Operation:
115/230 VAC (+10%, -20%), 47 to 63 Hz

DC Operation:
11 to 28 VDC

Power:
18 Watts

DC POWER OUTPUT:

15 VDC (+1, -2).
150 mA if powered from AC or less than 24 VDC.
100 mA if powered from 24 VDC or greater.

NOTE: DC power output is only regulated if unit is powered by AC or greater than 18.5 VDC.

ENVIRONMENT:

Operating Temperature:
32 to 130° F (0 to 55° C)

Storage Temperature:
-40 to 160° F (-40 to 70° C)

Operating Humidity:
85% non-condensing relative

PHYSICAL:

Case Dimensions:
5.28" W x 2.62" H x 5.91" D
(136.7mm W x 66.5mm H x 150.1mm D)

Bezel Dimensions:
5.80" W x 3.04" H x 0.17" D
(147.3mm W x 77.2mm H x 4.3mmD)

LIP:
0.2 (5mm)

Panel Cut-out Dimensions:
5.43" W x 2.68" H
(138mm W x 68mm H, DIN)

Mounting Panel Thickness:
0.58" (14.7mm) maximum
(without optional spacer provided)

0.077" (1.96mm) maximum
(with optional spacer provided)

Front panel will provide watertight seal with gasket provided.

Case Material:
Cadon FRX plastic case with Lexan front face overlay

Weight:
2.2 lbs. (1.0Kg)

Display Size:
6 digits, 0.56" (14.2mm) H
(with programmable decimal point location)

Memory Types:
PROM, RAM, Non-volatile NVRAM

COUNTER:

Count Range:
6 digits (0 to 999,999) with rollover

Preset Range:
6 digits (0 to 999,999) (2 Preset Ranges)

Count Modes:
Count with Add and Subtract inputs
Count with Up/Down direction input
(Hardware doubling for above modes is provided.)
Count with Count Inhibit input
Quadrature
Doubled Quadrature

Count Speed:
0 to 10,000* counts per second (CPS) with
Durant Shaft Encoders or solid state sensors
with internal pull-up resistor.
0 to 7,500* CPS minimum for sensors with open
collector transistor output.
0 to 5,000* CPS when hardware doubling is
implemented.
0 to 150 CPS when Low Frequency jumpers are
installed.

*Count speeds are reduced proportionately to the
Scale Factor on Model 5884-1400.

SPECIFICATIONS

COUNT INPUT RATINGS:

The count inputs are designed to work with current sinking sensors (open-collector NPN transistor output with or without passive pull-up resistor) or contact closures to DC Common.

Input Voltage:

High state (Logical "1", sensor off or contact open):
10.5 to 24.5 VDC when control is powered by AC line
7.0 to 24.5 VDC when control is powered by 11 VDC
11.0 to 24.5 VDC when control is powered by 16 VDC

Low state (Logical "0", sensor on or contact closed):

0 to 4.5 VDC when control is powered by AC line
0 to 3.0 VDC when control is powered by DC supply

Input Impedance:

6800 ohms to 15 VDC when control is powered by AC line
6800 ohms to 10 VDC when control is powered by DC supply

Input Current:

20 mA peak, 3 mA steady state

Input Response:

High State (Logical "1", sensor off or contact open)
High Speed (Low Speed jumpers not connected):
110µsec minimum at 15 VDC (6,800 ohms to +DC)
160µsec minimum at 13.5 VDC (50,000 ohms to +DC)

High State (Logical "1", sensor off or contact open)

Low Speed (Low Speed jumpers connected):
5.5 msec minimum at 15 VDC (6,800 ohms to +DC)

7.5 msec minimum at 13.5 VDC (50,000 ohms to +DC)

Low State (Logical "0", sensor on or contact closed)

High Speed (Low Speed jumpers not connected):
20 µsec minimum at 0.1 VDC (0 ohms to DC Common)

45 µsec minimum at 1.5 VDC (500 ohms to DC Common)

Low State (Logical "0", sensor on or contact closed)

Low Speed (Low Speed jumpers connected):
1.0 msec minimum at 0.1 VDC (0 ohms to DC Common)

2.0 msec minimum at 1.5 VDC (500 ohms to DC Common)

BATCH:

Count Range:

6 digits (0 to 999,999) with rollover

Batch Preset Range:

6 digits (0 to 999,999)

Batch Count Mode:

Increment (Up Count) each time count value reaches Preset 2 (Reset mode) or zero (Preset mode).

CONTROL INPUTS:

Impedance:

4.75K ohms to +5 VDC.

Threshold:

High +3.5 to +22 VDC.
Low +0.0 to +1.0 VDC.

Response Time:

Min. High 5.3 mS.
Min. Low 3.9 mS.

NOTE: The reset and unlatch signals will both occur in less than 200 microseconds after the input signal is detected. The start of the print will occur within 2 milliseconds after the input is detected if the unit is not counting.

SPECIFICATIONS

OUTPUT RATINGS:

Relay Contacts

Type: Form C (SPDT)

U.L./C.S.A. Contact Ratings:

10 amps, resistive, @ 24 VDC or 230 VAC

1/3 HP @ 115 VAC or 230 VAC

150 VDC maximum switched voltage

Mechanical Life: 5,000,000 operations

Electrical Life: 100,000 operations at resistive rating

Transistor Outputs

Type: Open collector NPN transistor with Zener diode transient surge protection.

Load Voltage: 30 VDC maximum

Load Current: 300 milliamps maximum per transistor. 480 milliamps total for all transistors.

Rev. 50-59:

Use 90 milliamps per relay coil when calculating total transistor current.

Rev. 60 - up:

Use 5 milliamps per relay coil when calculating total transistor current.

OUTPUT OPERATING MODES:

Turn On:

At preset value (Reset mode) (Output 1 and 2 transistors)

At preset value (Preset mode) (Output 1 transistors only)

At zero (Preset mode) (Output 2 transistors only)

At Batch Preset (Batch Output transistor only)

Turn Off:

After timeout

At unlatch input signal (Outputs 1 and 2 only)

When reset energized (Unlatch at reset)

When reset deenergized (Latch until reset complete)

At alternate preset (Outputs 1 and 2 only)

Unlatch Function code (Totalizer Output only)

Reverse:

Reversed operation of transistors (Any outputs)

COUNTER OPERATING MODES:

Reset: Reset to zero and count to preset 2

Preset: Reset to preset 2 and count to zero

Auto Recycle

Maintained Reset

Momentary Reset

DIAGNOSTIC MODES:

ROM Checksum

RAM Bit Test

NVRAM Read/Write Test

NVRAM Store Test

NVRAM Checksum

Watchdog Timer

Display and LED Indicator Test

COMMUNICATIONS:

Interface Type:

Dual port 20 milliamp current loop

Speed:

110, 300 and 1200 Baud, user selectable

Data Type:

Standard ASCII code

Format:

Start bit, 7 ASCII data bits, Parity bit, one or two Stop bits

(Even Parity for Serial Data Output, no Parity for Serial Data Input)

Information Transmitted:

Count value

Preset 1 value

Preset 2 value

Batch Count

Batch Preset

Scale Factor (Model 5884-1400 only)

Information Received:

Print request

Preset 1 value

Preset 2 value

Batch Preset

Scale Factor (Model 5884-1400 only)

SCALE FACTOR:

Range:

5 digits (0.0001 to 9.9999)

DESCRIPTION OF OPERATING MODES

COUNT MODES

The control has five count modes, which are: Count with separate add and subtract inputs, Count with direction control input, Count up with inhibit control input, Quadrature, and Doubled Quadrature.

Add and Subtract Inputs

The add and subtract mode allows separate signals to simultaneously add and subtract counts. It can be used to indicate material stretch, subtract defective parts from total parts produced, etc.

Count with Directional Control

Count with direction control mode uses one input for incoming count pulses and the other to inform the control whether the pulses should be used to add or subtract counts. Count with direction may be used when an item must be measured or positioned. Many types of sensors or control systems utilize count signals of this nature.

In both of the above count modes, the counter will normally increment or decrement on the falling edge of the incoming count pulse. (The falling edge is defined as the moment in time when the pulse changes state from +DC to DC Common potential.) Doubling allows the counter to increment or decrement on both the falling and the rising edges of the pulse. (The rising edge is defined as the moment when the pulse changes state from DC Common to +DC potential.)

Count With Inhibit Control

The count up with inhibit control mode provides an input which increments the control and an input which causes incoming count pulses to be ignored. This mode can be used when defective material must be ignored or when inspection samples are taken without incrementing the counter. The count up with inhibit control mode may not be doubled.

Quadrature Inputs

Quadrature counting makes use of two count signals which are phase shifted by 90 degrees. The detection of which signal is rising first allows the counter to know in what direction the shaft is turning. When Quadrature count sources are being used, the Double Input must always be connected to DC

Common to allow the quadrature signals to be decoded.

Quadrature Input Doubled

Doubled Quadrature is implemented by programming. This mode allows the counter to count on both the rising and falling edges of the incoming count pulses. The number of pulses per revolution of the shaft encoder is effectively doubled, increasing the resolution without any loss of accuracy.

COUNT SCALING

When the 5884-1400 receives a count pulse in any count mode, the 1 pulse is multiplied by the Scale Factor. The 5884-1400 adds the scaled value to the result for count-up pulses and subtracts the scaled value from the result for count-down pulses. The display shows the accumulated total in whole increments.

DECIMAL POINT LOCATION

The location of the decimal point on the display is programmed and may be located between any two digits on the display, or omitted. When a printer is connected to the serial communication output, the decimal point is printed.

The decimal point remains on the display whenever the actual value of the counter or either one of the preset values is being displayed. It is not lit when function codes or other function entries are being displayed. The timeout function automatically displays the decimal point to indicate 0.01 second increments.

COUNTER OPERATING MODES

Reset Mode Vs. Preset Mode

Reset mode is used when the counter should start at zero and count up to the preset values. Reset mode implies that when the "RESET" key is pressed or the Reset input is energized, the counter is reset to zero. In most cases when the Reset mode is programmed, the counter is initialized to zero before the process being controlled is started. When the control is in the Reset mode, the Output 2 transistors turn on when the counter reaches the preset 2 value (assuming Normal Output mode of operation).

DESCRIPTION OF OPERATING MODES

FUNCTIONAL OPTIONS SELECTED

EVENT	RESET MODE						PRESET MODE					
	NORMAL OUTPUTS			REVERSE OUTPUTS			NORMAL OUTPUTS			REVERSE OUTPUTS		
	NORMAL	LURC	UAR	NORMAL	LURC	UAR	NORMAL	LURC	UAR	NORMAL	LURC	UAR
Counter reaches a Preset value	ON	ON	ON	OFF	OFF	OFF	ON*	ON*	ON*	OFF*	OFF*	OFF*
Counter reaches zero	-	-	-	-	-	-	ON**	ON**	ON**	OFF**	OFF**	OFF**
Crop input is energized and outputs are selected in Function 77	ON	ON	ON	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
"RESET" key pressed or Reset input energized	-	-	OFF	-	-	ON	-	-	OFF	-	-	ON
"RESET" key released or Reset input deenergized	-	OFF	-	-	ON	-	-	OFF	-	-	ON	-
Unlatch input energized	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	ON	ON	ON
Timeout function (if used) times out	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF	ON	ON	ON

"ON" indicates that the Transistor outputs turn on
 "OFF" indicates that the Transistor outputs turn off
 "-" indicates that there is no change

*Transistor output 1 only
 **Transistor output 2 only

Figure 3. Output and Relay Operation Table

Preset mode is used when the control must start at a preset value and count down to zero. Preset mode implies that when the "RESET" key is pressed or the Reset input is energized, the control is reset to preset 2; that is, forced to have a value equal to the preset 2 value. In most cases when the Preset mode is programmed, the counter is initialized to the preset 2 value before the process is started. When the control is in the Preset mode, the output 2 transistors turn on when the counter reaches zero (assuming Normal Output mode operation).

Automatic Recycle Operation

It may be desirable to have the control automatically reset itself for repeated cycles. Programming the Auto Recycle mode causes the control to automatically reset when it reaches Preset 1, Preset 2 or either, as the user desires. When in the Reset mode and the control reaches coincidence with the

selected preset value, the transistor outputs for that preset turn on and the counter is automatically reset to zero.

When in the Preset mode and the control reaches Preset 1 or zero, the transistor outputs for that preset turn on and the counter is automatically reset to the Preset 2 value.

BATCH COUNTER OPERATION

A second internal counter is included with the control. This counter is called the Batch Counter. It is typically used to count or control the number of operation cycles the control will/does complete. Each time the standard counter reaches Preset 2 (Reset mode) or zero (Preset mode) the Batch Counter increments by 1 count. A Batch Preset may be established to provide an output whenever a given number of operation cycles have been completed.

DESCRIPTION OF OPERATING MODES

Whenever the Batch counter reaches the Batch Preset value, it automatically resets to zero. When multiple batches are to be produced, this allows the process to automatically continue after the completion of a batch.

OUTPUT AND RELAY OPERATION

The outputs of the control consist of five transistors and two relays. The output associated with Preset 1 and the output associated with Preset 2 each provides a pair of transistors. The two transistors in each pair operate in parallel; that is, when one of the transistors for Output 1 is turned on, the other is turned on as well. Likewise, when one of the transistors for Output 2 is turned on, the other is also turned on. The fifth transistor is associated with the Batch counter. The collectors of each of these transistors is brought out to individual screw terminals.

The relays are uncommitted and may be assigned by the user to any of the 5 transistor outputs. This is done by connecting a single wire for each relay to the desired transistor output screw terminal. When shipped from the factory relay K1 is prewired to Output 1 (terminal 8) and relay K2 is prewired to Output 2 (terminal 9).

Outputs 1 and 2

The Output 1 transistors turn on (conduct to DC common) whenever the counter reaches the Preset 1 value. The Output 2 transistors turn on whenever the counter reaches the Preset 2 value (when the unit is operating in the Reset mode) or zero (when the unit is operating in the Preset mode).

Several of the user programmed functions affect the operation of Outputs 1 and 2. Figure 3 provides a table showing the various functions and their effects on the outputs. The functions shown are:

Output Status Operation (NORMAL/REVERSE)
Latch Unit Reset Complete (LURC)
Unlatch At Reset (UAR)
Reset or Preset mode select (RESET/PRESET)

Note that if an output is already off when the event specified occurs and the table indicates that it should turn off, it remains off. Likewise, if it is on and the table shows that it should turn on, it remains on.



WARNING

A POWER OUTAGE CAUSES THE OUTPUTS TO TURN OFF REGARDLESS OF THE OPERATING MODE SELECTED. BE SURE THAT THIS EFFECT IS NOT HAZARDOUS TO THE OPERATOR.

	NORMAL OUTPUT			REVERSE OUTPUT		
EVENT	NORMAL	LURC	UAR	NORMAL	LURC	UAR
Batch counter reaches the Batch Preset value	ON	ON	ON	OFF	OFF	OFF
Crop Input is energized and Batch Output is selected in Function 76	ON	ON	ON	OFF	OFF	OFF
"RESET" key pressed or Reset Input energized	---	---	OFF	---	---	ON
"RESET" key released or Reset Input deenergized	---	OFF	---	---	ON	---
Unlatch Function code utilized	OFF	OFF	OFF	ON	ON	ON
Timeout Function (if used) times out	OFF	OFF	OFF	ON	ON	ON

Figure 4. Batch Output Operation Table

DESCRIPTION OF OPERATING MODES

Once a pair of transistor outputs are energized, they remain on until unlatched by energizing the associated Output Unlatch input. Unlatch 1 input unlatches Output 1. Unlatch 2 input unlatches Output 2.

The Timeout Function allows an output to remain on for a time period which is user adjustable. The range of time allowable is from 0.01 to 99.99 seconds. At the end of the time duration specified, the output automatically turns off. As the table in Figure 3 shows, this operation is reversed if the Reverse Operation of a transistor output has been programmed. A value of 0.00 causes the Timeout Function to be inhibited. In this case the transistor output remains on until the Unlatch input is energized. Outputs 1 and 2 may be set to different timeout values.

The "RESET" key or the Reset input may also be used to turn the outputs off if the Latch Until Reset Complete function or the Unlatch At Reset function has also been programmed. Unlatch at Reset turns them off when the "RESET" key is pressed or the Reset input is energized. Latch Until Reset Complete turns them off when the "RESET" key is released or the Reset input is deenergized. Outputs 1 and 2 may be Unlatched at Reset or Latched Until Reset Complete independently.

If either the Unlatch At Reset or Latch Until Reset Complete mode is selected, the "RESET" key or input, the Unlatch input, or the Timeout function will unlatch the associated relay and transistor output.

In this case, the relay and transistor are unlatched by whichever occurs first.

Batch Output

The Batch Output turns on whenever the value of the Batch Counter reaches the Batch Preset. A separate adjustable timeout function is provided for the Batch Output, if desired. Alternately, the Batch Output may be Latched Until Reset Complete or Unlatched At Reset.

The Batch Output may be unlatched manually via the keyboard using a function code. Figure 4 provides a table showing these functions and their effect on the Batch Output.

CROP INPUT

A special input is included with the control which allows one or more of the outputs (any combination of Output 1, Output 2 and/or Batch Output) to be energized. This allows a machine or process to be re-synchronized via an external contact closure. The Crop Input can also be used to allow the removal of an inspection sample from the process.

Once one or more of the outputs are energized using the Crop Input, they must be turned off by a Timeout, an Unlatch Input or a LURC or UAR function. If the Auto Recycle mode has been selected, the Crop Input also causes the counter to Auto Recycle. If the Reset on Crop mode has been selected, the Counter resets at the same time that the outputs change state.

INSTALLATION INSTRUCTIONS

GENERAL

When mounting, the location selected must provide for adequate air circulation space around the unit. Avoid locating the unit near instruments and/or equipment that generate excessive heat. Figure 5 shows recommended cutout and product dimensions as well as mounting details.

GENERAL WIRING PRACTICES

1. Disconnect all power before wiring terminals. **A safety hazard exists if this precaution is not observed. Treat all control and count inputs as hazardous since they may carry line voltage.**

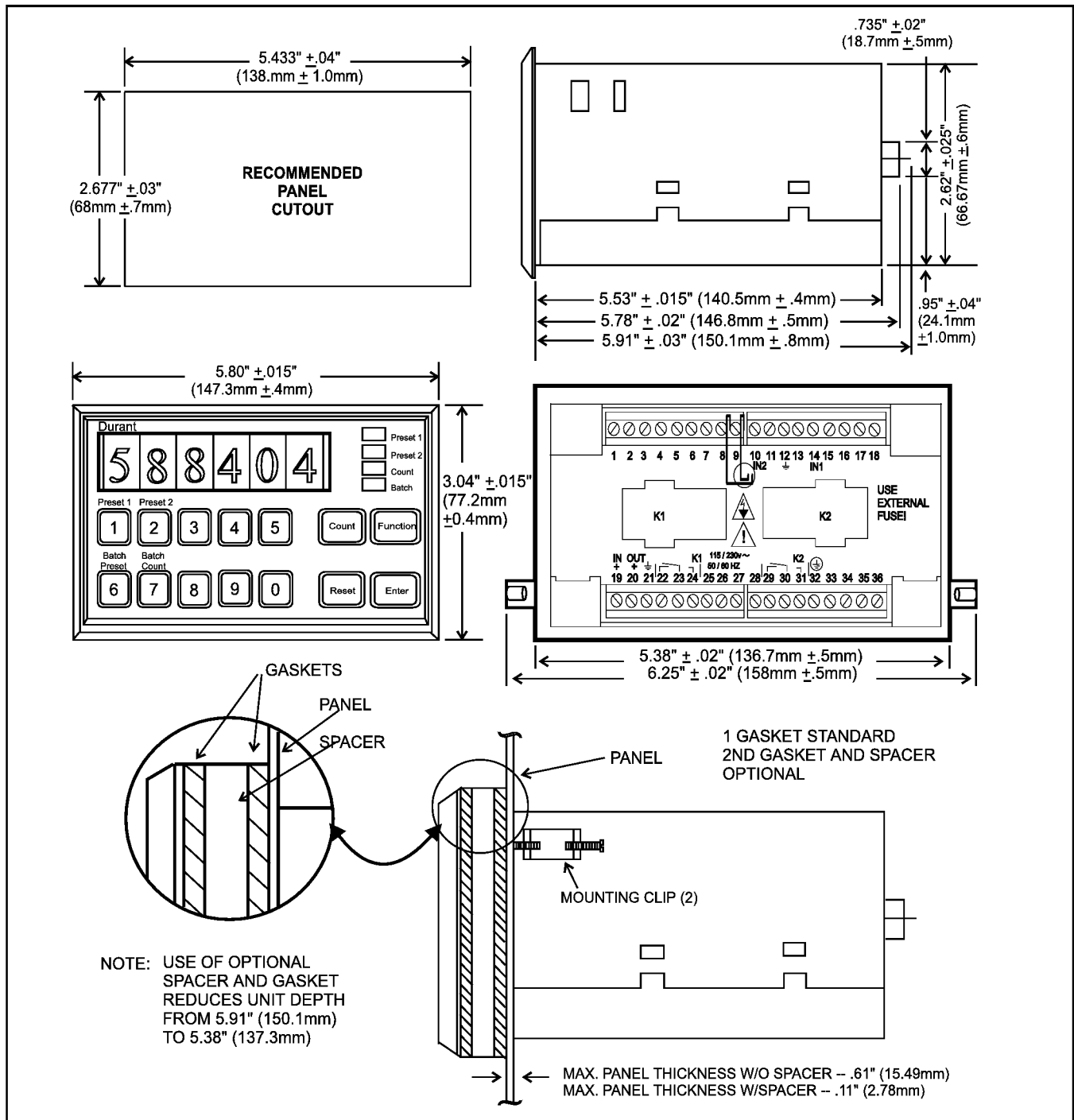
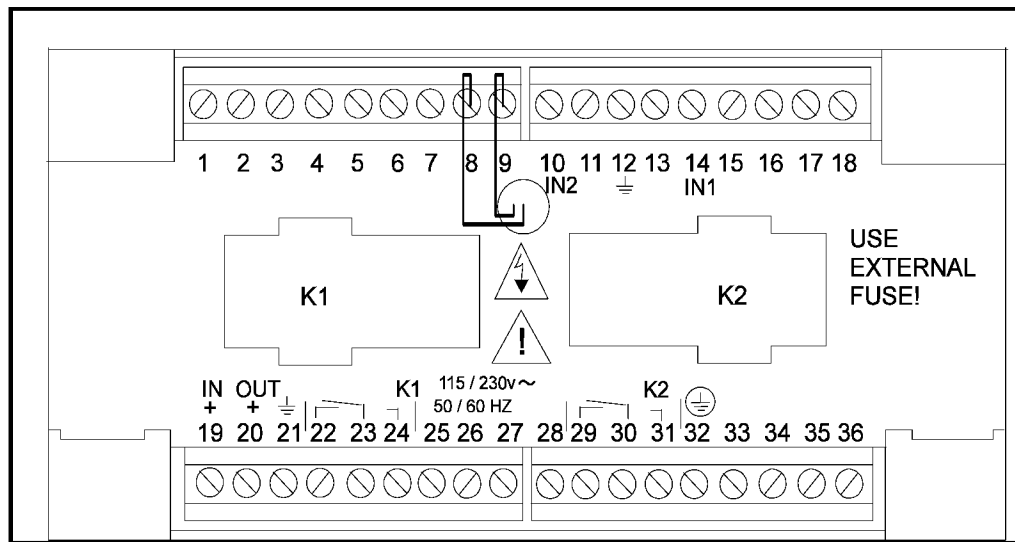


Figure 5. Panel Mounting Dimensions

INSTALLATION INSTRUCTIONS

2. Use shielded cables for count signals, control input and communications signals. Connect shield to common (terminal 2, 3, or 4) of counter to terminate properly.
3. Keep all signal lines as short as possible.
4. Do NOT bundle or route signal lines with power or machine control wiring. Use separate conduit for power and signal wires.
5. Provide "clean" power to the counter. In severe cases, power may have to be filtered or a separate power source used. Do not use the same power source that is supplying the loads.
6. Use 18 ga. minimum (1mm², 600V) and 14 ga. maximum (2.1mm², 600V) wire for AC power wiring.
7. See Figure 8 for the correct fuse to be used in the power input wiring.



TERMINAL IDENTIFICATION

1	BYPASS PRESET 1 INPUT	19	11-16V DC SUPPLY
2	OUTPUT UNLATCH 1	20	15V DC POWER OUTPUT
3	OUTPUT UNLATCH 2	21	DC COMMON
4	CROP INPUT	22	RELAY CONTACT NC
5	TRANSISTOR OUTPUT 1	23	RELAY CONTACT COM
6	TRANSISTOR OUTPUT 2	24	RELAY CONTACT NO
7	BATCH TRANSISTOR OUTPUT	25	AC POWER INPUT
8	TRANSISTOR OUTPUT 1	26	AC POWER INPUT
9	TRANSISTOR OUTPUT 2	27	AC POWER INPUT
10	COUNT INPUT 2	28	AC POWER INPUT
11	LOW FREQUENCY SELECT 2	29	RELAY CONTACT NC
12	DC COMMON	30	RELAY CONTACT COM
13	LOW FREQUENCY SELECT 1	31	RELAY CONTACT NO
14	COUNT INPUT 1	32	CHASSIS GROUND
15	PROGRAM INHIBIT	33	SERIAL DATA INPUT -
16	PRINT REQUEST/DISPLAY LATCH	34	SERIAL DATA INPUT +
17	RESET	35	SERIAL DATA OUTPUT +
18	DOUBLE INPUT	36	SERIAL DATA OUTPUT -

Figure 6. Terminal Designations

INSTALLATION INSTRUCTIONS

TERMINAL ASSIGNMENTS AND FUNCTIONS

#1 - BYPASS PRESET 1 INPUT

Connecting this terminal to DC Common causes the counter to ignore Preset 1, regardless of the value entered. As the counter is counting and reaches Preset 1, Output 1 remains unenergized, effectively bypassing Preset 1 operation.

#2 - OUTPUT 1 UNLATCH INPUT

When this input terminal is connected to DC Common through a contact closure or current sinking solid state sensor, Output 1 unlatches. If the output is not energized, connection to this terminal has no effect. If the output has been programmed to time out and the time out period has begun, energization of this input will turn the output "OFF" prematurely. If the Reverse-Outputs mode is selected, this input Latches rather than Unlatches the output.

#3 - OUTPUT 2 UNLATCH

This input operates the same as #2 above except it applies to Output 2.

#4 - CROP INPUT

When this input is connected to DC Common through a contact closure, any combination of Output 1, Output 2 and/or the Batch Output may be energized, depending on user selection. Either of the Unlatch Inputs override the effect of the Crop Input. The Crop Input energizes Output 1 only if the bypass Preset 1 Input (terminal #1) is not energized.

If the Reset on Crop mode is selected, the counter is reset when the Crop Input is energized. This allows the machine or process to be resynchronized with the counter.

#5 and 8 - TRANSISTOR OUTPUT 1

These outputs are open collector NPN transistors with built-in transient overvoltage protection in the form of zener diode clamping. Each transistor is rated at 30 VDC maximum and can sink up to 300 milliamps.

Both transistors are energized whenever the counter reaches the Preset 1 value.

#6 AND 9 - TRANSISTOR OUTPUT 2

These outputs operate the same as #5 and #8 above except that they energize whenever the counter reaches the Preset 2 value in the Reset mode or zero in the Preset Mode.

#7 - BATCH OUTPUT

This output operates the same as #5 and #8 above except that it energizes whenever the Batch counter reaches the Batch Preset.

#12 and 21 - DC COMMON

These terminals are internally connected to the negative side of the DC power supply.

#10 and 14 - COUNT INPUTS

These two count inputs are used to increment or decrement the counter. Terminal #14 is labeled

COUNT MODE	INPUT 1 (Term. #14)	INPUT 2 (Term. #10)
Separate add and subtract	Subtract counts	Add counts
Count up with inhibit control	Add counts	Inhibit counts
Quadrature*	Input A	Input B
Count with up/down control	Count Input	Up/Down control
Doubled quadrature*	Input A	Input B

*NOTE: For both Quadrature modes, the wires to inputs 1 and 2 may be interchanged to reverse count. Terminal #18 must also be tied to DC Common (terminal #12) for proper quadrature operation.

Figure 7. Count Input Operating Modes

INSTALLATION INSTRUCTIONS

“COUNT INPUT 1” and terminal #10 is “COUNT INPUT 2”. The table shown in Figure 7 lists the operation of the two count inputs as related to the count function, and indicates how each input causes the counter to operate when a DC Common signal is applied.

#11 and 13 - LOW FREQUENCY SELECT INPUTS

When contact closures are used for count sources, it must be remembered that the contacts will bounce slightly each time they close. This slight bounce can cause extra counts to be entered into the counter. This effect can be eliminated by limiting the allowable frequency response at the count inputs. The low frequency select terminals reduce the count input frequency response from 7500 PPS to 150 PPS when they are connected to DC Common. Terminal #13 is LOW FREQUENCY SELECT for COUNT INPUT 1 (terminal #14) and terminal #11 is LOW FREQUENCY SELECT for COUNT INPUT 2 (terminal #10). Low frequency is selected by placing a jumper between terminal #11 and/or terminal #13 and DC Common. Use the Low Frequency inputs whenever possible to guard against electrical noise and interference.

#15 - PROGRAM INHIBIT INPUT

The PROGRAM INHIBIT terminal, when connected to DC Common through the use of a jumper, prevents all of the programming functions from being changed. Modification of the Preset values can also be prevented with this jumper if Function Code 41, Preset Lock, is set to a “1”.

#16 - PRINT REQUEST/DISPLAY LATCH

When the PRINT REQUEST terminal is connected to DC Common, the current count value or the current preset value or both are immediately transmitted through the SERIAL DATA OUTPUT terminals, #35 and #36. The data is transmitted once each time the Print Request input is energized. The input must be deenergized and energized again for each transmission. The type of information transmitted is controlled by the Send Data function.

This terminal also serves to latch the value on the display while the control continues counting. When this terminal is energized, the count value being displayed is stored on the display and remains latched while the input is energized. The display

returns to showing the value of the counter when the input is deenergized.

#17 - RESET INPUT

When terminal #17 is connected to DC Common through an external switch, relay, or sensor, the counter is remotely reset. If the counter is programmed to be in the Reset mode, energizing this input returns the counter value to zero. If the counter is programmed to be in the Preset mode, the counter value is changed to the preset value. In either case, if the Unlatch at Reset or Latch Until Reset Complete mode of operation is selected, for either Output 1 or 2 or both, the input unlatches the selected combination of transistor outputs and relays, in addition to resetting the control. The Reset input has the same function as the front panel “RESET” key.

If the Batch Output Unlatch at Reset mode is selected, the Batch Output unlatches when the reset key is pressed or input is energized. If the Batch Output Latch Until Reset Complete mode is selected, the Batch Output unlatches when the reset key is released or Input is deenergized.

#18 - DOUBLE INPUT

Connecting the DOUBLE INPUT to DC Common selects count doubling for either the Add and Subtract or the Count with Direction Control count modes. When either Quadrature or Doubled Quadrature count mode is selected, the Double Input must be connected to DC Common for proper operation.

#19 - BATTERY OR EXTERNAL 11-16 VDC SUPPLY

The power source can be either an external battery (11 to 16 volts) or a 15 VDC power supply. Connect this terminal to the positive side of the external low voltage supply and a DC Common terminal to the negative side.

#20 - 15 VDC POWER OUTPUT

This terminal may be used to power external devices such as sensors, a shaft encoder, or indicator lamps. The terminal supplies a regulated 15 VDC (+1V, -2V) to the loads at a maximum of 100 milliamps. The 15 VDC supply is generated only when the unit is powered by 115 or 230 VAC.

INSTALLATION INSTRUCTIONS

#22 through 24 and #29 through 31 - RELAY CONTACTS

Each of the 2 internal relays provides a set of 5 amp resistive dry form "C" contacts (SPDT) rated at 115 or 230 VAC. For K1 terminal #23 is common to terminal #22(NC) and terminal #24 (NO). For K2 terminal #30 is common to terminal #29(NC) and terminal #31(NO).

#25 through 28 - AC POWER INPUT

For 115 VAC operation, jumper terminal #25 to #28 and #26 to #27. Connect the AC line power to #25 and #26.

For 230 VAC operation, jumper #26 to #28. Connect the AC line power to #25 and #27.

#32 - CHASSIS GROUND

This terminal must be connected to earth ground to provide proper noise immunity. When shielded cable is used for sensors or communications wiring, connect the shields to this terminal.

When the unit is being used in a mobile, battery powered application, this terminal **MUST** be connected to CHASSIS GROUND.

A factory installed green wire connects this terminal to DC Common. This is done to provide added immunity to static discharge and electrical interference. In control systems incorporating several electronic devices, it is accepted practice to provide one SYSTEM grounding point. In this case the green wire as provided may be removed and SEPARATE green wires attached to both Chassis Ground and DC Common for connection to the common system grounding point.

For applications which require isolated DC Common and Chassis Ground, the green jumper may be removed entirely. However, extra care must be taken to route current carrying wires away from the counter as much as possible. Shields in transducer cables should be connected to Chassis Ground whenever possible.

#33 and 34 - SERIAL DATA INPUT

The serial communications inputs are used to receive new preset values and print requests. The interface utilized is a standard 20 milliamp current loop with a user selectable Baud rate.

Terminal #33 is the negative side of the current loop and #34 is the positive side. When connecting serial communications between the unit and any other device, note that SERIAL DATA OUT PLUS (SDO+) from the transmitting device is wired to the SERIAL DATA IN MINUS (SDI-) of the counter. Likewise, SDO- from the transmitting device is wired to SDI+ of the counter.

#35 and 36 - SERIAL DATA OUTPUT

The counter has serial communications output which may be used to transmit the current count value, the preset 1 value, the preset 2 value, the Batch Count, the Batch Preset or any combination. The Baud rate of the 20 milliamp current loop is user selectable. However, the Baud rate selected is the same for serial input and serial output communications.

Terminal #36 is the negative side of the output current loop and terminal #35 is the positive side. When connecting serial communications between the counter and any other device, note that SERIAL DATA OUT PLUS (SDO+) from the counter is wired to the SERIAL DATA IN MINUS (SDI-) of the device receiving the data. Likewise, SDO- from the counter is wired to SDI+ of the receiving device.

WIRE LEADS - Gray and White/Yellow - RELAY COILS

These leads supply power to the coils of the relays on the rear of the counter. The gray lead is connected to K1 and the White/Yellow lead is connected to K2.

As shipped from the factory, K1 is prewired to Output 1 (terminal 8) and K2 is prewired to Output 2 (terminal 9). These terminals provide conduction to DC common when energized. The opposite side of both relay coils is internally connected to +12 VDC.

INTERCONNECTION

After determining the desired operating mode, select the appropriate figure 8 through 22 for connection diagrams for the application.

INSTALLATION INSTRUCTIONS/WIRING

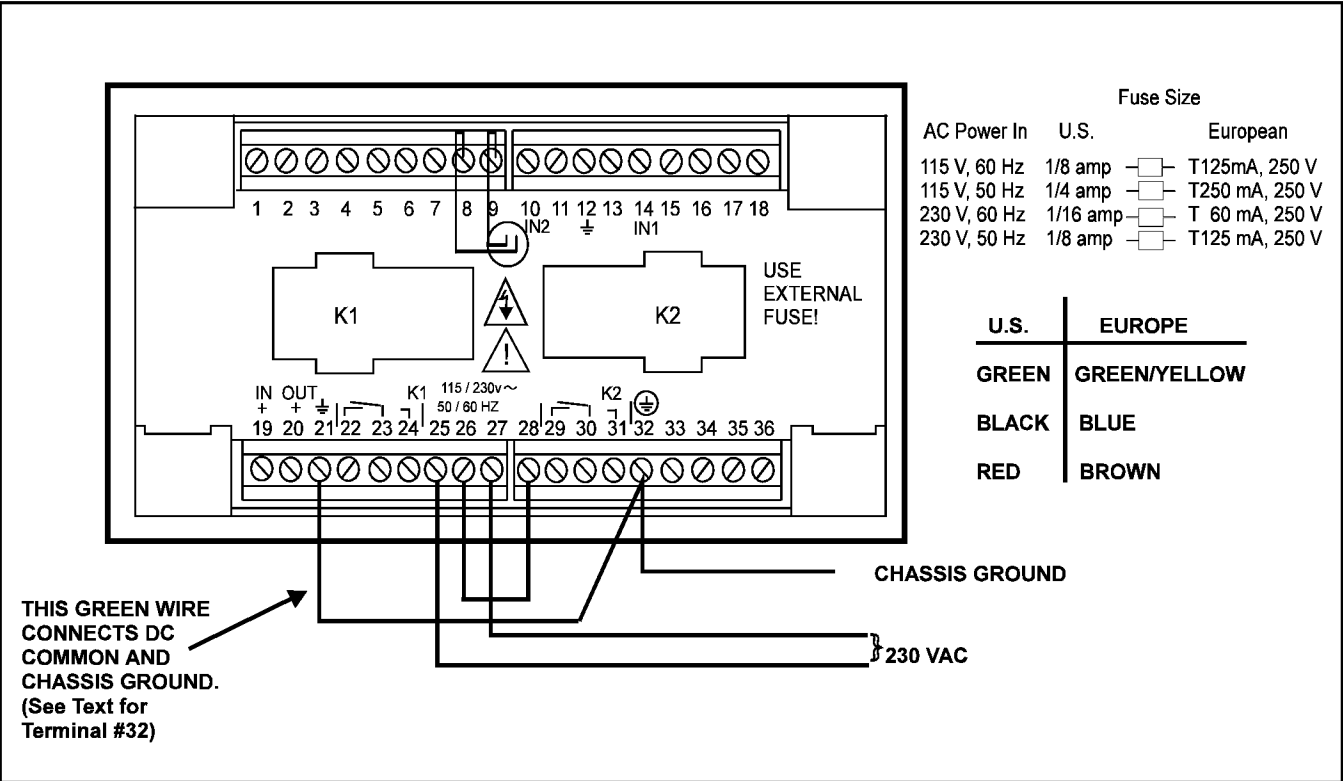


Figure 9. 230 VAC 47/63 Hz Power Connection

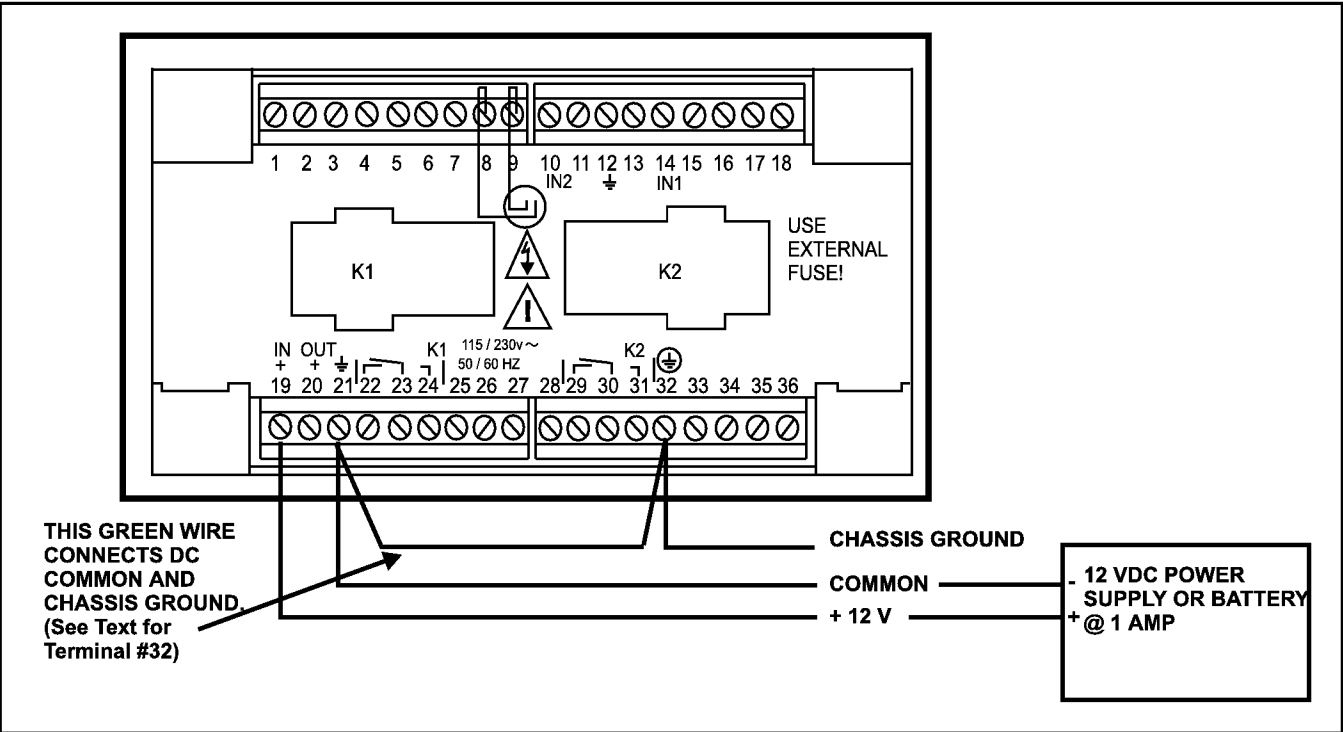
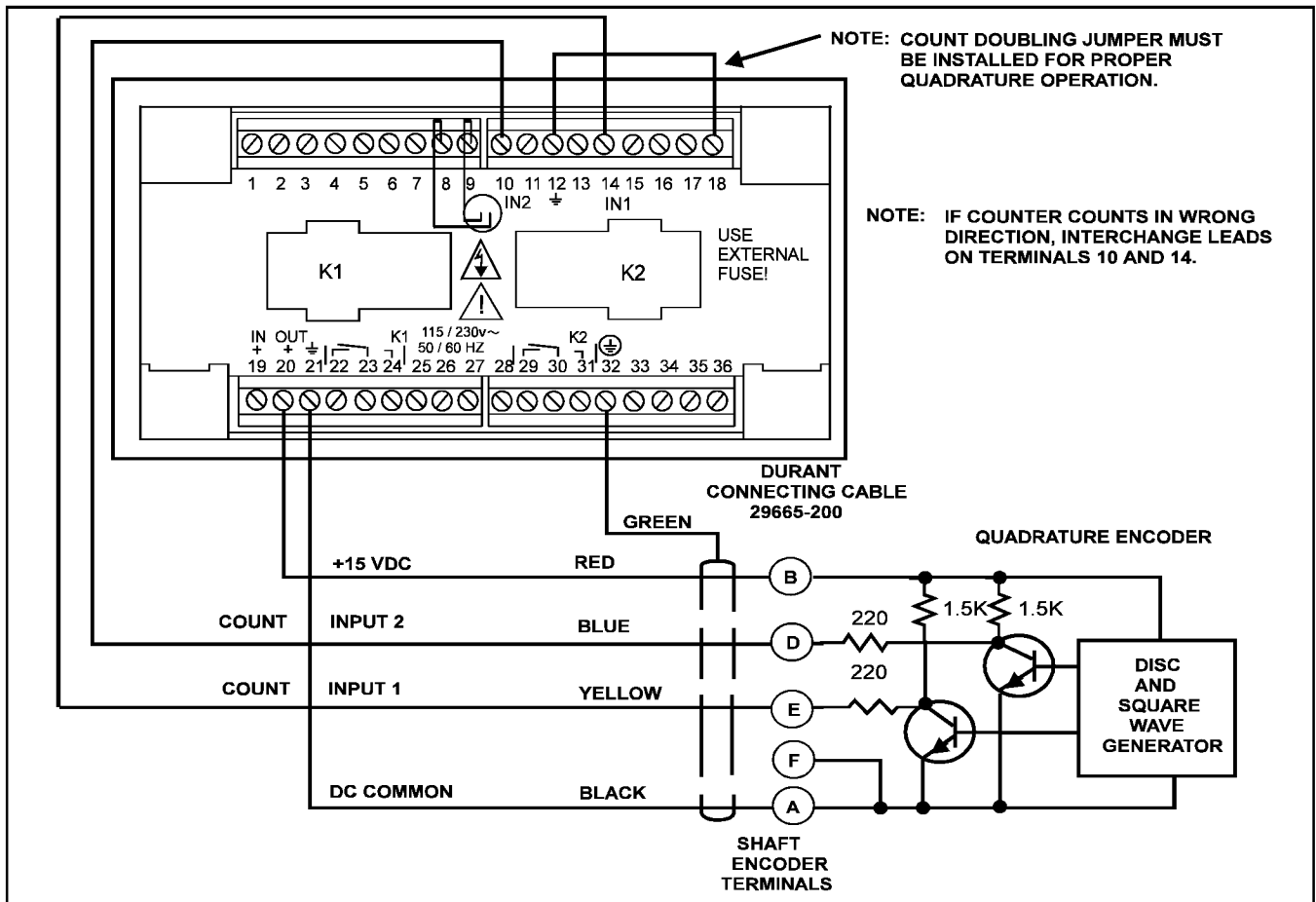
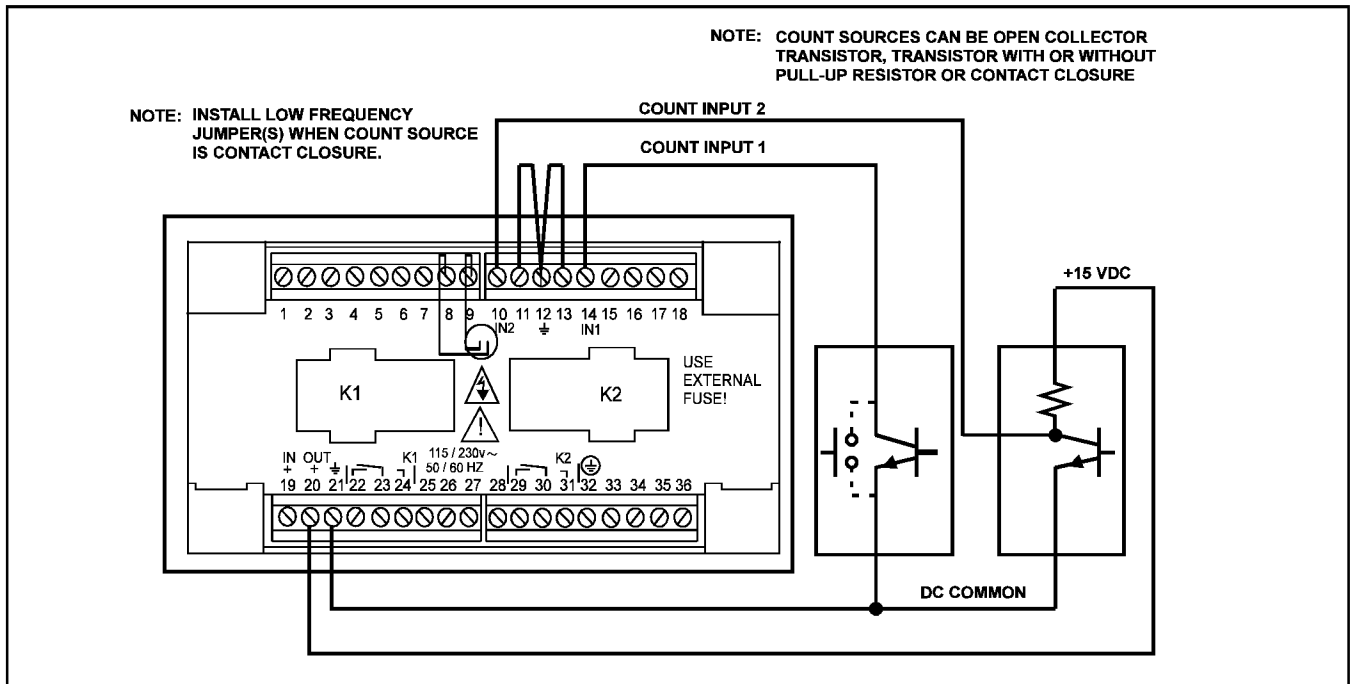


Figure 10. 12 VDC Power Connection

INSTALLATION INSTRUCTIONS/WIRING



INSTALLATION INSTRUCTIONS/WIRING

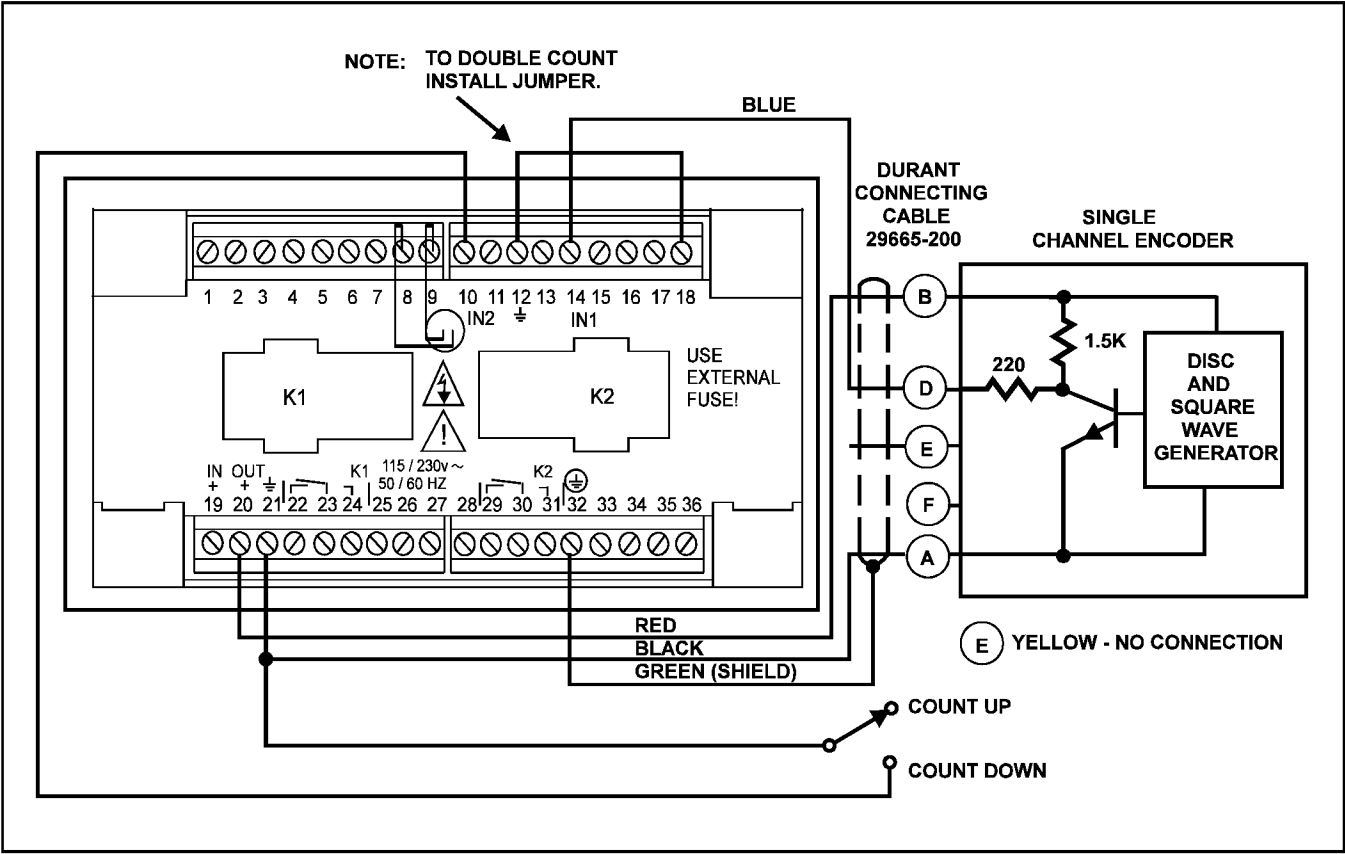


Figure 13. Encoder with Directional Control Count Input Wiring

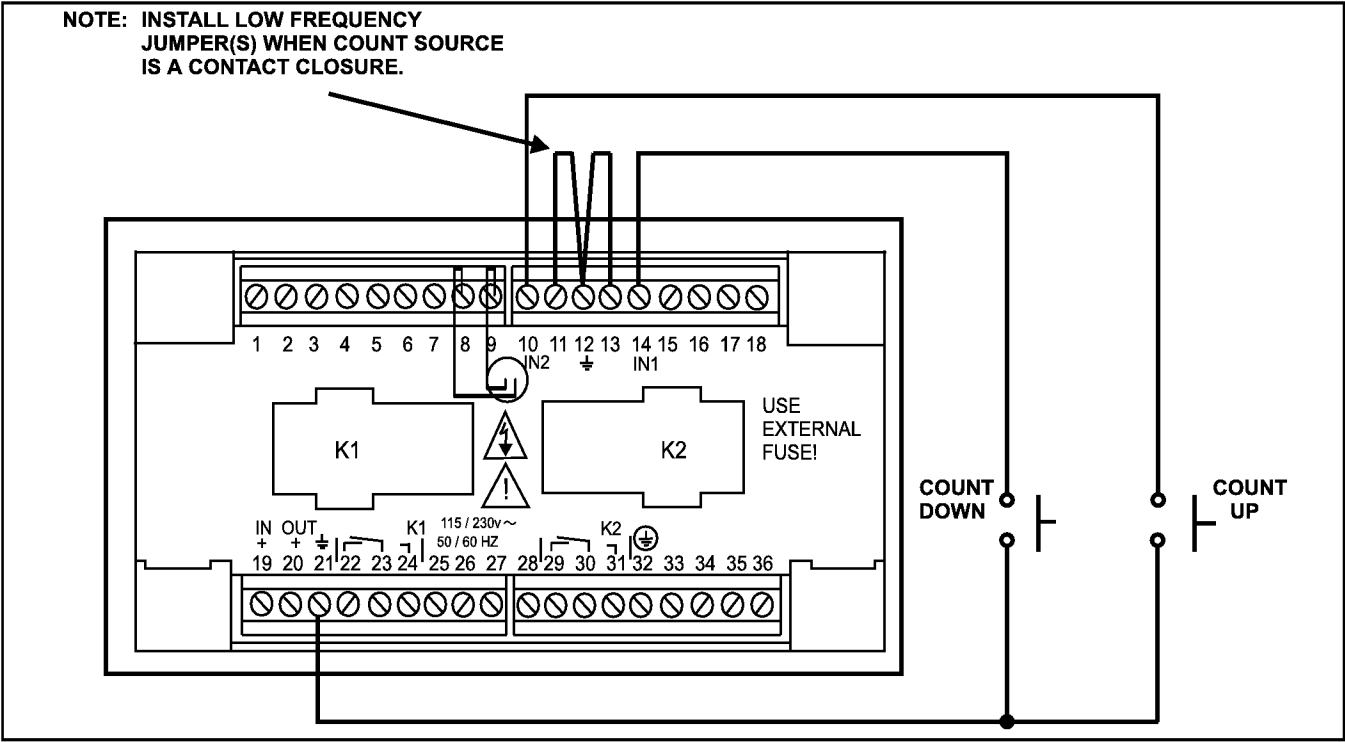


Figure 14. Add and Subtract Count Input Wiring

INSTALLATION INSTRUCTIONS/WIRING

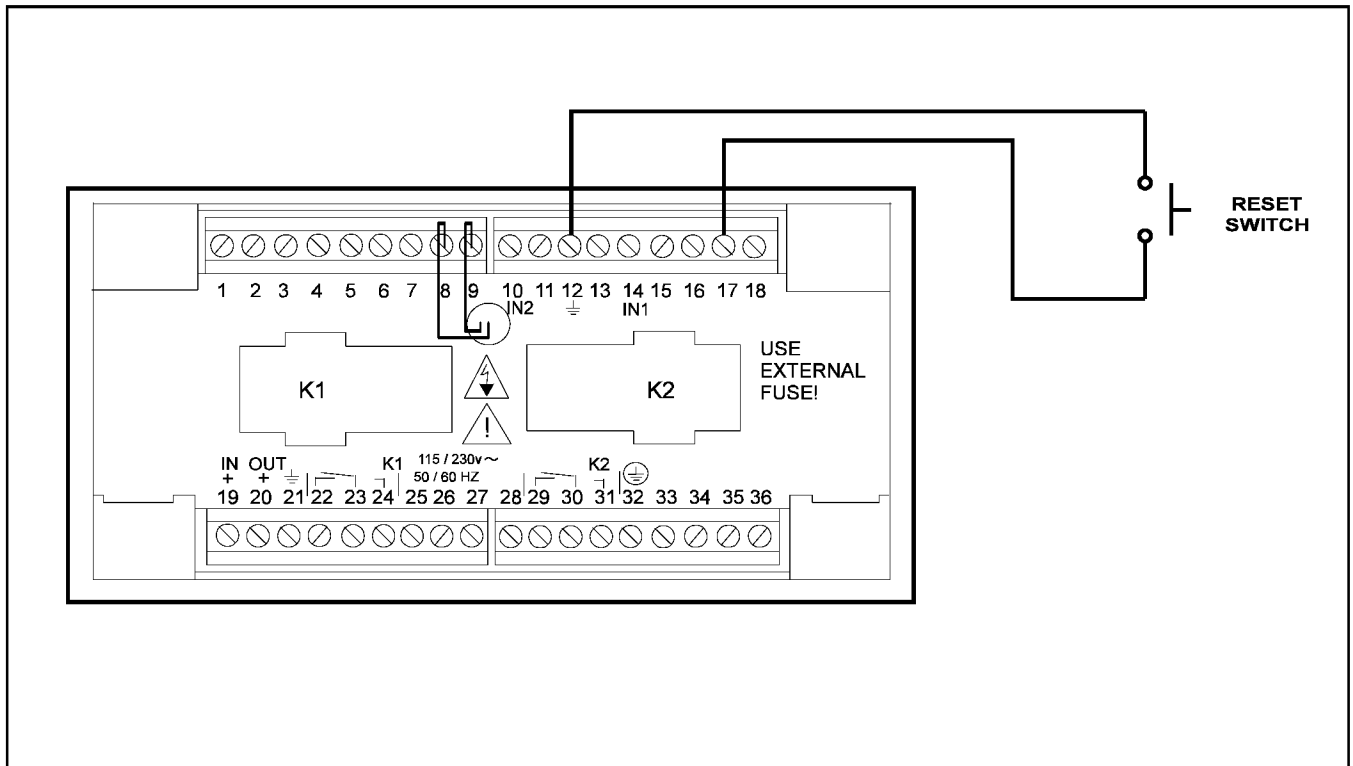


Figure 15. Remote Reset Wiring

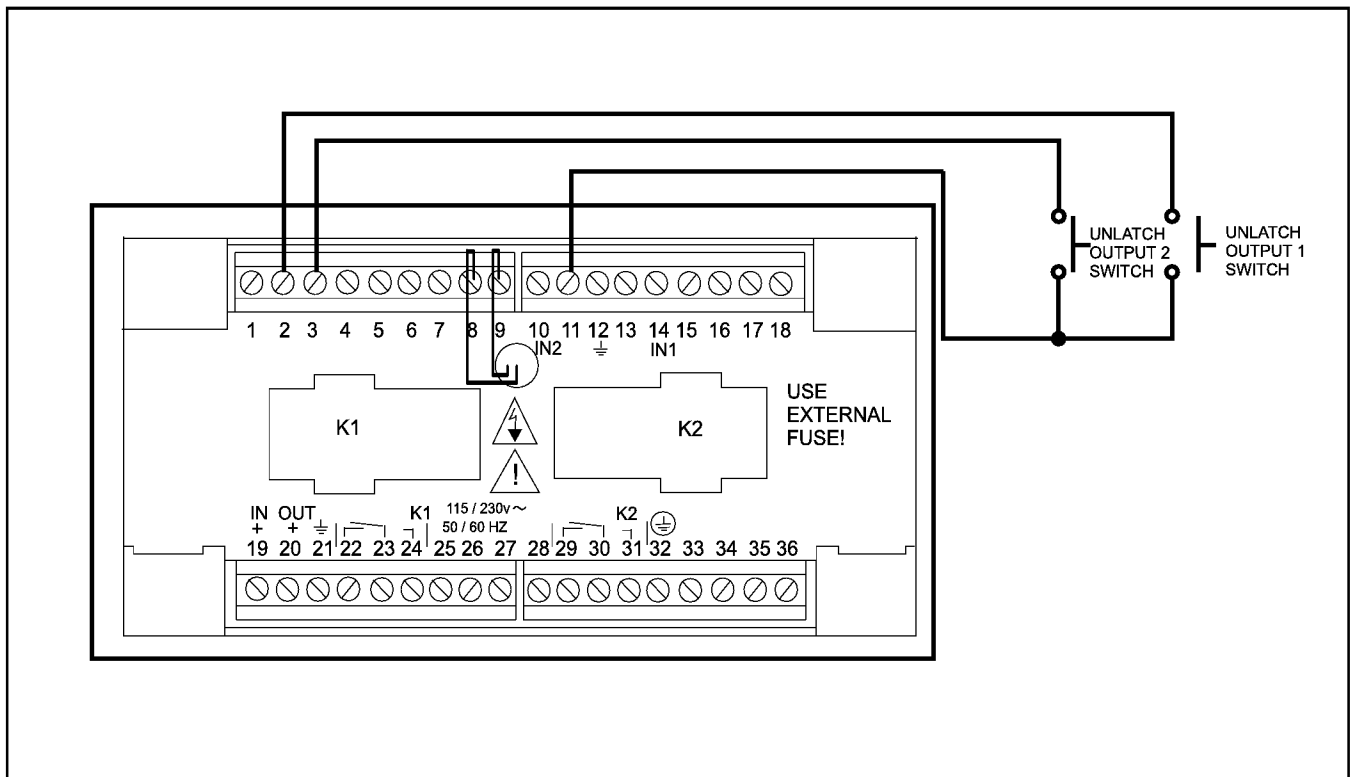


Figure 16. Latch Until Contact Closure Wiring

INSTALLATION INSTRUCTIONS/WIRING

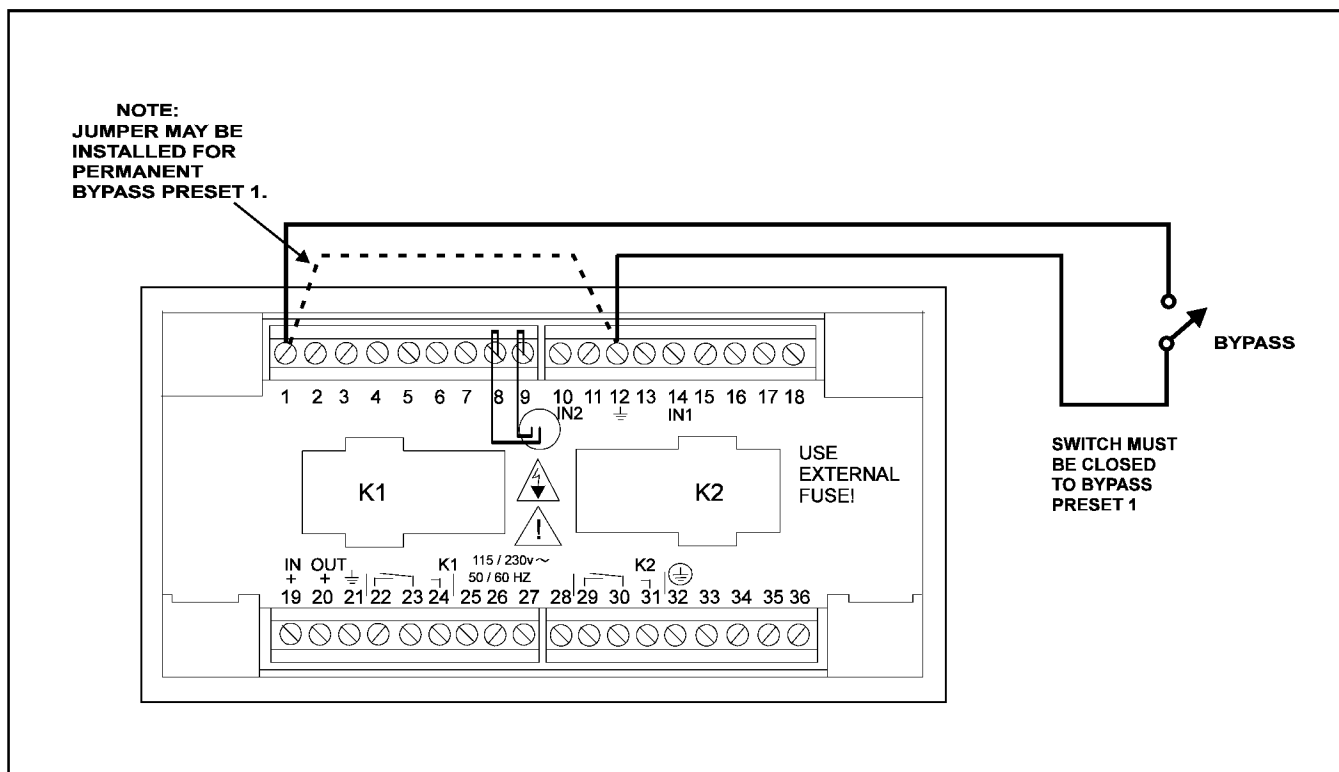


Figure 17. Bypass Preset Input Wiring

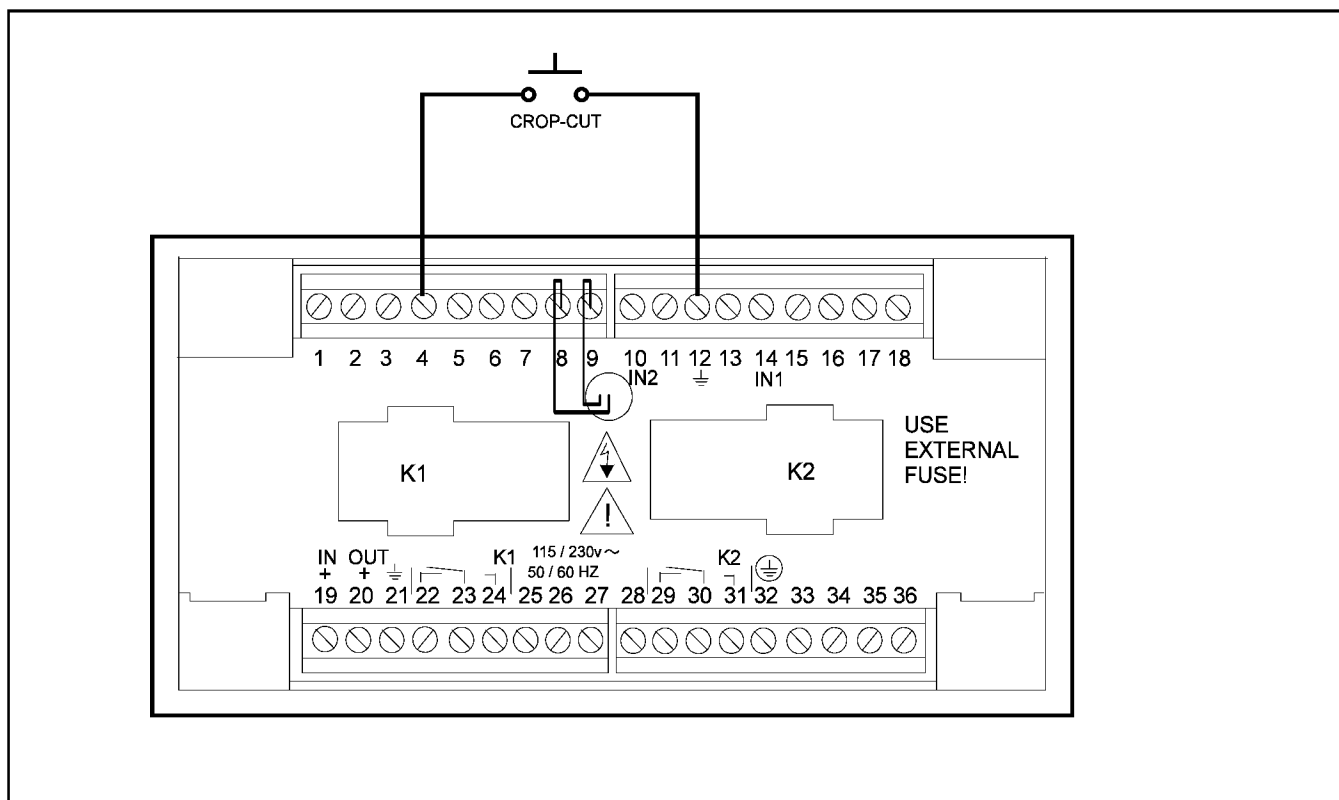


Figure 18. Wiring the Crop Input

INSTALLATION INSTRUCTIONS/WIRING

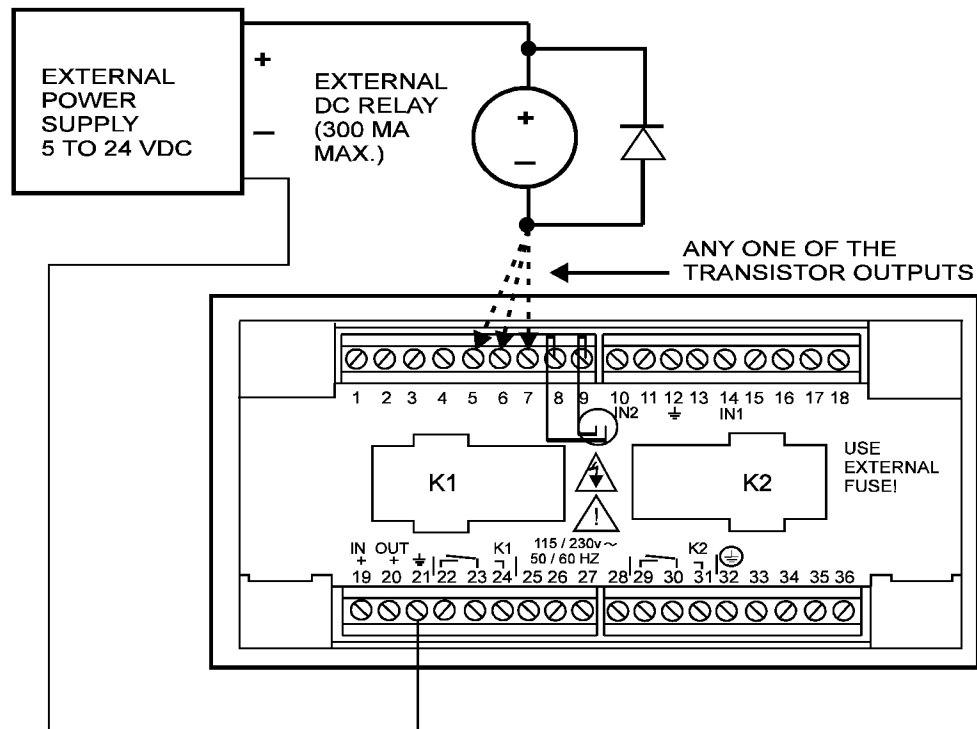


Figure 19. Using Transistor Output to Drive Loads

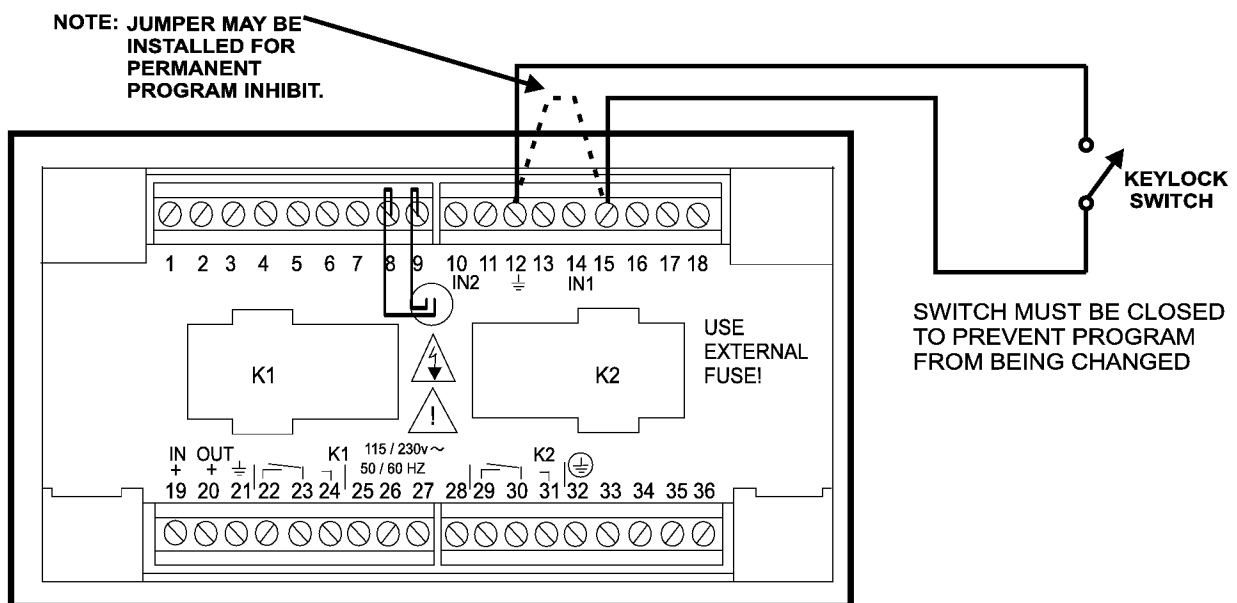


Figure 20. Program Inhibit Wiring

INSTALLATION INSTRUCTIONS/WIRING

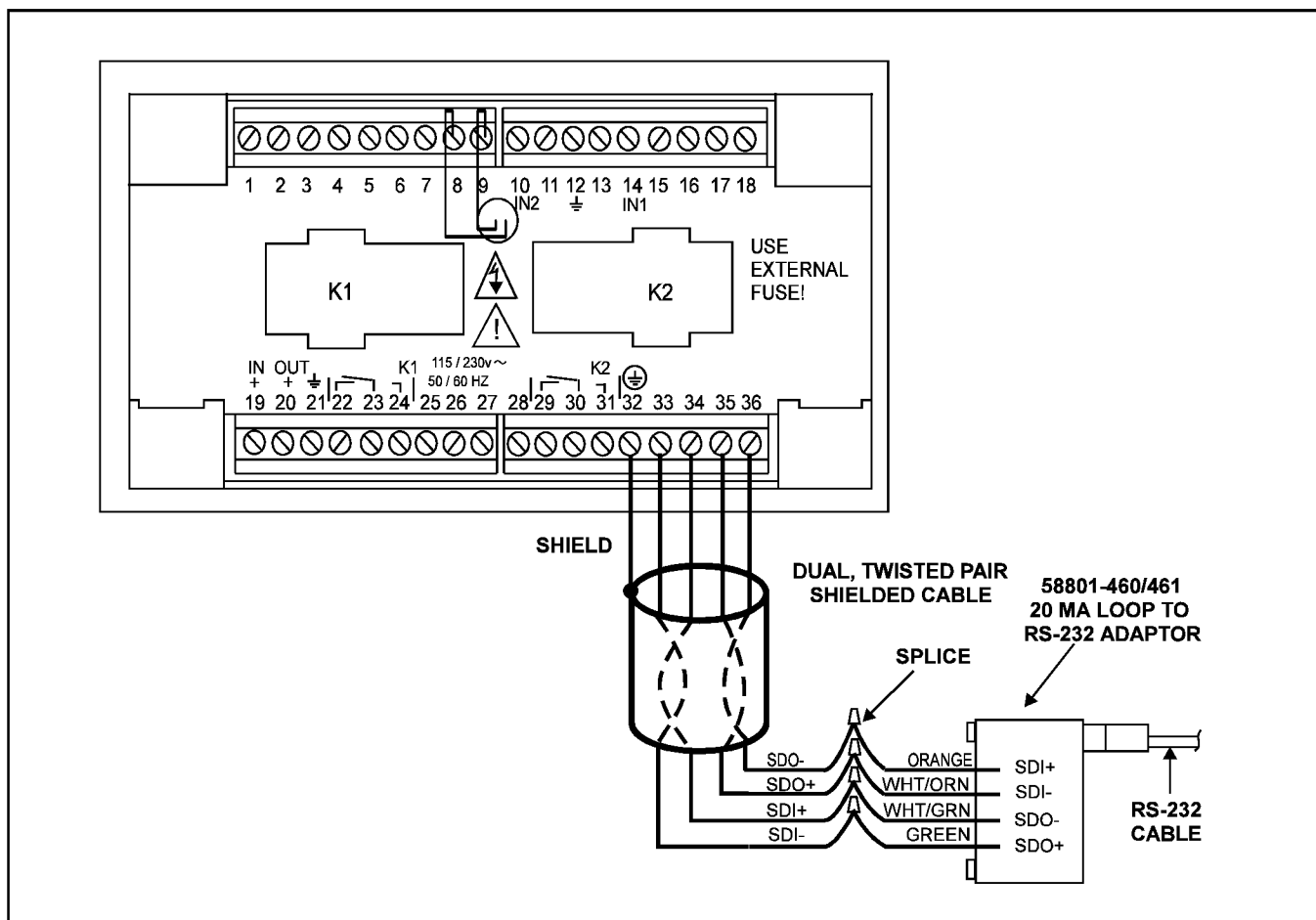


Figure 21. Serial Communications to Durant Communications Convertor

OPERATION

DISPLAY

The six-digit numeric display normally indicates the counter value. When presets or functions are being programmed, the display indicates either the function code or the data being programmed. When power is applied to the counter, the display flashes at 1/2 second intervals for 4 seconds. The counter will accept count pulses during this period.

INDICATORS

Four yellow LED indicators in the form of "light bars" are located to the right of the display. These light bars indicate what is being displayed, the count value, preset 1 value, preset 2 value, the Batch Count value or the Batch Preset value. All four are off when functions are being interrogated or modified.

KEYBOARD

Data Entry Keys (0 through 9)

The data entry keys are used to enter preset values, function codes and parameters.

"PRESET 1" Key (1)

The "1" key also serves as the "PRESET 1" key. The "PRESET 1" key is used to select the Preset 1 value for interrogation or modification.

"PRESET 2" Key (2)

The "2" key also serves as the "PRESET 2" key. The "PRESET 2" key is used to select the Preset 2 value for interrogation or modification.

"BATCH PRESET" Key (6)

The "6" key also serves as the "BATCH PRESET" key. The "BATCH PRESET" key is used to select the Batch Preset value for interrogation or modification.

"BATCH COUNT" Key (7)

The "7" key also serves as the "BATCH COUNT" key. The "BATCH COUNT" key is used to select the Batch counter for interrogation. The value of the Batch counter cannot be modified using the "BATCH COUNT" key.

"COUNT" Key

The use of this key after an interrogation or modification of an operating function will cause the count to display.

"FUNCTION" Key

The "FUNCTION" key is used to change the programmable functions. When this key is pressed and followed by 2 digit code, the function to be interrogated or modified is selected.

The "FUNCTION" key permits the programming of all functions except the presets.

"RESET" Key

The "RESET" key is used to reset the counter. If the "Unlatch At Reset" or the "Latch Until Reset Complete" function is programmed, the "RESET" key may be used to unlatch the transistor output and relay.

"ENTER" Key

When the "FUNCTION" key is pressed and a code is entered, the "ENTER" key is used to terminate and enter the code. The "ENTER" key is also used to terminate and enter a programmed value or a preset value.

FUNCTION CODES

The control has many different programmable operating modes and selectable options. The user must select which of these functions will be used and how they should operate by specifying a Function Code on the keyboard and entering the correct value choice to select the desired mode. The functions may be reprogrammed at any time if the Program Inhibit terminal (terminal #15) is not connected to DC Common.

While the user is programming the various functions and their entry choices, the counter continues to operate normally, even though the display does not indicate the current value of the counter. This allows the operating parameters to be changed while the process being controlled is running. See Figure 23 for a complete table of the functions and their allowable entry choices.

OPERATION



WARNING

CHANGING FUNCTION CODE VALUES WHILE THE PROCESS IS OPERATING MAY BE HAZARDOUS TO THE OPERATOR AND/OR THE MACHINERY. USE EXTREME CAUTION. IT IS RECOMMENDED THAT THE PROCESS BE STOPPED BEFORE FUNCTION CODE VALUES ARE MODIFIED WHENEVER POSSIBLE.

If an invalid Function Code is specified, the control ignores the selection and displays the current count value. An invalid Function Code is any code not listed in Figure 22.

If an invalid value is entered in a Function Code, the control ignores the entry and retains the previous setting. An invalid value is any value other than those allowable values listed in Figure 22.

When shipped from the factory, the control is programmed with the Function Codes set as indicated in Figure 22 with asterisks (*). When the user changes the values for any or all of the functions, the new values are stored in the non-volatile memory of the counter. This means that the new values are permanently stored until reprogrammed, even if power fails.

If it is desired to return the control to the factory set values after being reprogrammed, enter a value of "1" in Function 43.

FUNCTION	FUNCTION CODE	ENTRY CHOICES	DESCRIPTION
CURRENT COUNT VALUE	COUNT KEY	NONE	Shows current count value.
PRESET 1	PRESET 1 KEY ("1" KEY)	*0 to 999,999	Defines Preset 1 value. (Factory set value is zero.)
PRESET 2	PRESET 2 KEY ("2" KEY)	*0 to 999,999	Defines Preset 2 value. (Factory set value is zero.)
BATCH PRESET	BATCH PRESET KEY ("6" KEY)	*0 to 999,999	Defines Batch Preset value. (Factory set value is zero.)
BATCH COUNT	BATCH COUNT KEY ("7" KEY)	NONE	Selects current Batch Count value for display only.
SCALE FACTOR (Model 5884-1400 only)	5	0.0001 to 9.9999 *1.0000	Defines scale factor value. (Factory set value is 1.0000.)
COUNT OPERATION MODE	60	*0 1 1 2 3	Count with separate add (Input 2) and subtract (Input 1) Count up (Input 1) with Inhibit control (Input 2). NOTE: This mode cannot be doubled with double input. Quadrature. NOTE: Double input MUST be connected to DC Common. Count (Input 1) with up/down control (Input 2). Doubled Quadrature. NOTE: Double input MUST be connected to DC Common.

NOTE: Choices shown with asterisks are the factory set values.

Figure 22. Function Code Programming Table

OPERATION

FUNCTION	FUNCTION CODE	ENTRY CHOICES	DESCRIPTION
DECIMAL POINT DISPLAY LOCATION	62	*0 1 2 3 4 5	No decimal points are displayed. 00000.0 0000.00 000.000 00.0000 0.00000
TRANSISTOR OUTPUT 1 TIMEOUT OPERATION	30	.00 0.01 to 99.99 *10.00	No timeout. Transistor output remains on remains on until unlatched via Unlatch input. Unlatch input refers to Terminal 2 or reset input with FC36 or 39 set at 1 or 3. Seconds of delay before transistor output unlatches. Factory set value.
TRANSISTOR OUTPUT 2 TIMEOUT OPERATION	31	.00 0.01 to 99.99 *10.00	No timeout. Transistor output remains on until unlatched via Unlatch input. Unlatch input refers to Terminal 3 or reset input with FC36 or 39 set at 2 or 3. Seconds of delay before transistor output unlatches. Factory set value.
BATCH OUTPUT TIMEOUT OPERATION	32	.00 0.01 to 99.99 *10.00	No timeout. Transistor output remains on until unlatched via Unlatch input. Unlatch refers to FC71 = 1 (one shot unlatch) or reset in with FC73 or 75 set at Seconds of delay before transistor output unlatches. Factory set value.
TRANSISTOR OUTPUT OPERATION	33	*0 1 2 3	Normal outputs. Reverse Output 1 only. Reverse Output 2 only. Reverse both outputs.
UNLATCH AT ALTERNATE PRESET	35	*0 1 2 3	No unlatch at alternate presets. Unlatch Output 1 at Preset 2. Unlatch Output 2 at Preset 1. Unlatch Output 1 at Preset 2 and Output 2 at Preset 1.

NOTE: Choices shown with asterisks are the factory set values.

Figure 22. Function Code Programming Table (continued)

OPERATION

FUNCTION	FUNCTION CODE	ENTRY CHOICES	DESCRIPTION
TRANSISTOR OUTPUT LATCH UNTIL RESET COMPLETE	36	*0 1 2 3	See Figure 3 for description. No LURC. LURC Output 1 only. LURC Output 2 only. LURC Output 1 and Output 2.
TRANSISTOR OUTPUT UNLATCH AT RESET	39	*0 1 2 3	See Figure 3 for description. No UAR. UAR Output 1 only. UAR Output 2 only. UAR Output 1 and Output 2.
PRESET LOCK	41	*0 1	Presets Unlocked. Presets Locked when Program Inhibit (terminal 15) is connected to DC Common.
RESET/PRESET MODE SELECT	80	*0 1	Reset mode. Counter is reset to zero when the "RESET" key is pressed or the reset input (terminal #17) is energized. Transistor Output 1 changes state when the value of the counter reaches the Preset 1 number. Transistor Output 2 changes state when the counter reaches the Preset 2 number. Preset mode. Counter is reset to the Preset 2 number when the "RESET" key is pressed or the reset input (terminal #17) is energized. Transistor Output 1 changes state when the value of the counter reaches the Preset 1 number. Transistor Output 2 changes state when the value of the counter reaches zero.
AUTO RECYCLE	81	*0 1 2 3	No Auto Recycle. Counter continues to count after either preset coincidence is reached. Auto Recycle. Counter automatically resets (Reset mode) or presets (Preset mode) at Preset 1. Counter automatically resets (Reset mode) or presets (Preset mode) at Preset 2. Counter automatically resets (Reset mode) or presets (Preset mode) at either Preset 1 or Preset 2.

NOTE: Choices shown with asterisks are the factory set values.

Figure 22. Function Code Programming Table (continued)

OPERATION

FUNCTION	FUNCTION CODE	ENTRY CHOICES	DESCRIPTION
RESET INPUT OPERATING MODE	82	*0 1	Maintained. Counter remains reset until the Reset input is deenergized or the "RESET" key is released. Momentary. Instantaneously reset when input is energized or when "RESET" key is pressed. Then allows counter to operate normally regardless of whether reset input is held energized or "RESET" key is continuously being pressed.
SCALER RESET (Model 5884-1400 only)	83	0 *1	Reset Scaler when Reset Key is pressed or when Reset Input is energized. Reset Scaler as above or when Counter performs Auto Recycle.
RESET BATCH COUNTER	70	*0 1	Batch Counter operates normally. Force the Batch Counter to be reset to zero. Once reset, Function 70 automatically returns to an entry of 0.
BATCH OUTPUT UNLATCH	71	*0 1	Batch Output operates normally. Force the Batch Output to Unlatch. If already unlatched, this code has no effect. Once Unlatched, Function 71 is automatically returned to an entry of 0.
BATCH OUTPUT OPERATING MODE	72	*0 1	Batch Output operates normally. (OFF until Batch Counter reaches the Batch Preset, then ON.) Reverse Batch Output. (ON until Batch Counter reaches the Batch Preset, then OFF.)

NOTE: Choices shown with asterisks are the factory set values.

Figure 22. Function Code Programming Table (continued)

OPERATION

FUNCTION	FUNCTION CODE	ENTRY CHOICES	DESCRIPTION
BATCH OUTPUT LATCH UNTIL RESET COMPLETE	73	*0 1	No Batch LURC. LURC Batch Output. (See Figure 4 for description.)
BATCH COUNT RESET MODE	74	*0 1	Batch Counter resets by using Function 70 or when the Batch Preset is reached. Reset Batch Counter with Reset Input or Reset Key or as above.
BATCH OUTPUT UNLATCH AT RESET	75	*0 1	No Batch UAR. UAR Batch Output. (See Figure 4 for description.)
BATCH OUTPUT CROP MODE	76	*0 1	No Crop for Batch Output. Batch Output Crop allowed. When Crop Input is energized, Batch Output energizes.
TRANSISTOR OUTPUTS 1 AND 2 CROP MODE	77	*0 1 2 3	No Crop for Outputs 1 and 2. Crop Output 1. When Crop Input is energized, a simulation of the counter reaching Preset 1 occurs and Output 1 is energized. If Auto Recycle at Preset 1 is selected in Function 81, the counter Auto Recycles. Crop Output 2 simulating the counter reaching Preset 2 as above. Crop both Outputs 1 and 2 simulating the counter reaching both Presets as above.
COMMUNICATING TYPE Proper selection of two digits, "XY", determines combination of values to be transmitted. "00" transmits all values, "37" transmits no values for the 5884-0400 and "77" transmits no values for the 5884-1400.	91	"Y" value *0 1 2 3 4 5 6 7	Transmit count and both preset values when Print Request input is energized or a Print Request incoming communication (ASCII "?") is received. Transmit count and Preset 2 only as above. Transmit Preset 1 and Preset 2 only as above. Transmit Preset 2 only as above. Transmit count and Preset 1 only as above. Transmit count only as above. Transmit Preset 1 only as above. Allow no transmission of Count, Preset 1 or Preset 2.

NOTE: Choices shown with asterisks are the factory set values.

Figure 22. Function Code Programming Table (continued)

OPERATION

FUNCTION	FUNCTION CODE	ENTRY CHOICES	DESCRIPTION
COMMUNICATING TYPE (continued)		"X" value	
(Model 5884-0400 only)		*0	Transmit Batch Count value and Batch Preset value as above.
		1	Transmit Batch Preset value only as above.
		2	Transmit Batch Count value only as above.
		3	Allow no transmission of Batch Count or Batch Preset.
(Model 5884-1400 only)		"X" value	
		*0	Transmit Batch Count value, Batch Preset value and Scale Factor as above.
		1	Transmit Batch Preset value and Scale factor only as above.
		2	Transmit Batch Count value and Scale Factor only as above.
		3	Transmit Scale Factor only as above.
		4	Transmit Batch Count value and Batch Preset value as above.
		5	Transmit Batch Preset value only as above.
		6	Transmit Batch Count value only as above.
		7	Allow no transmission of Batch Count, Batch Preset or Scale Factor.
RESET AT CROP	79	*0	No Reset at Crop.
		1	Reset at Crop. When Crop Input is energized, the counter is reset simultaneously with the energizing of outputs as specified in Functions 76 and 77. For proper operation, Function 77 must have a value of "1", "2" or "3".
COMMUNICATIONS SPEED	90	0	110 Baud (Send and receive data at 110 bits per second.)
		*1	300 Baud.
		2	1200 Baud.
PRINT ON RESET	92	*0	No Print on Reset. Print when Print Request input is energized or Print Request communication (ASCII "?") is received.
		1	Print on Reset. Print when Reset input is energized. Then automatically reset. No counts are lost with the Print on Reset option.
SELF-DIAGNOSTIC MODE	40	*0	Return to normal operation.
		1	Perform self-diagnostics. Returns to "0" upon successful completion.
SELECT FACTORY-SET PARAMETERS	43	0	Return to normal operation.
		1	Reset all function codes to the factory set values.

NOTE: Choices shown with asterisks are the factory set values.

Figure 22. Function Code Programming Table (continued)

OPERATION

CHANGING THE PRESET VALUE

The Preset values may be changed at any time regardless of whether the Program Inhibit jumper is installed or not. However, if FUNCTION CODE 41, Preset Lock, is set to “1” and the PROGRAM INHIBIT jumper is installed, the Presets are “locked” and cannot be changed unless the PROGRAM INHIBIT jumper is first removed.

To change the value of Preset 1, Preset 2, or the Batch Preset, follow these steps:

1. Press the “PRESET 1,” “PRESET 2” or “BATCH PRESET” key. The display will show the current value for that preset. If the value displayed is the same as the desired value, proceed to step 4.
2. Key in the new preset value. Upon pressing the first key, the current preset value disappears and the digit which was pressed appears. Each successive digit displays as it is pressed.
3. Press the “ENTER” key. The display blanks for a moment and then redisplay the new preset. This confirms that the new value has been entered.
4. Press the “COUNT” key. The display returns to showing the current count value.
5. If another preset must be entered, return to step 1.

PREVENTING PRESET MODIFICATION

To avoid accidental change to the preset values, it is recommended that the ability to change the Presets be inhibited whenever possible.

To allow the Presets to be inhibited, Function Code 41, Preset Lock, must be set to a “1”. In this mode, Preset 1, Preset 2, and the Batch Preset values cannot be changed when the Program Inhibit input

is energized (see “Inhibiting Program Modifications” below).

DISABLING THE FRONT PANEL RESET KEY

Select the Momentary Reset mode (enter “1” in Function 82) and install a jumper from the reset input (terminal 17) to DC Common. This disables the Front Panel Reset key and prevents the operator from accidentally resetting the counter.

The jumper may be replaced by a normally closed contact. In this case, the counter is reset externally by opening and closing this contact. If power is interrupted, the counter is not reset when power is reapplied.

INHIBITING PROGRAMMING MODIFICATIONS

The function codes and their values may be accessed and modified whenever the control has power applied, including times when the process being controlled is running.



WARNING

CHANGING FUNCTION CODE VALUES WHILE THE PROCESS IS OPERATING MAY BE HAZARDOUS TO THE OPERATOR AND/OR MACHINERY. USE EXTREME CAUTION. WHENEVER POSSIBLE, STOP THE PROCESS BEFORE ATTEMPTING TO MODIFY FUNCTION CODE VALUES.

To avoid accidental change to the function code values, it is recommended that the ability to change them be removed by installing a jumper between the PROGRAM INHIBIT terminal and DC Common on the rear of the control. When installed, all of the functions may be interrogated but not modified.

PROGRAMMING PROCEDURES

GENERAL

This section deals with the selection and entry of the function codes and their values. The step-by-step procedure is given for entry of function codes followed by a discussion of the procedure used to determine which combination of features is needed to satisfy a specific application of the control. Once a decision has been made, certain parts of this section may be skipped as indicated.

PROGRAMMING FUNCTION CODES

Function codes may be programmed or interrogated at any time while the control is operating.



WARNING

CHANGING FUNCTION CODE VALUES WHILE THE PROCESS IS OPERATING MAY BE HAZARDOUS TO THE OPERATOR AND/OR MACHINERY. USE EXTREME CAUTION. WHENEVER POSSIBLE, STOP THE PROCESS BEFORE ATTEMPTING TO MODIFY FUNCTION CODE VALUES.

All functions including the preset values can be protected from accidental change by installing a jumper between the PROGRAM INHIBIT input (terminal #15) and DC Common. Modification to the Preset values is also inhibited in this mode if Function Code 41 is set to a "1". All functions may be interrogated but not changed with the jumper installed.

To change the operation of a function with the PROGRAM INHIBIT jumper removed, follow these steps:

1. Press the "FUNCTION" key. The display blanks indicating that the key has been pressed.
2. Select the two digit function code for the desired function. For example, press "30" to select the relay and transistor timeout value. The display indicates the two digits pressed for the function code. If more than two digits are pressed, the display only retains the last two digit entries.
3. Press the "ENTER" key. The current value for the specified function is displayed. If the value does not need to be changed, a new function

may be chosen by returning to step 1. The "COUNT" key may also be pressed to return to the count value.

4. Press the digit keys for the desired entry. Using the above example, a value of 100 could be entered to select 1.00 seconds of timeout. The display shows the value as the keys are pressed.
5. Press the "ENTER" key to store the new data. The display blanks temporarily as the control stores the information. If the entry is out of range for the selected function, the control ignores the entry and the previous value is retained.
6. The next function to be interrogated or modified may be specified. If no additional functions need to be selected, the control can be returned to displaying the current count value by pressing the "COUNT" key.

SELECTING MODES OF OPERATION

Count Input Mode

Depending on the configuration of the count sensors, the manner in which the counter operates must be selected. If two discrete sensors or contact closures are utilized, the counter should use the Separate Add and Subtract count mode, the Count with Direction Control mode or the Count Up with Inhibit Control mode. If a single channel shaft encoder is being used, the Count with Direction Control mode or Count Up with Inhibit mode can be selected. If the count source is a quadrature shaft encoder, either of the two Quadrature count modes should be used. Program Function 60 according to Figure 22 to select the count mode.

Reset Mode or Preset Mode

When the "RESET" key is pressed or the Reset input is energized, should the control start at zero and count to a preset value or start at a preset value and count to zero? If the former is desired, select the Reset mode with Function 80 (enter "0") and proceed with the "Reset Mode Operation" section following. If the latter, select the Preset mode (enter "1") and proceed on to the "PRESET MODE OPERATION" section skipping the "RESET MODE OPERATION" section following.

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Reset Mode Operation

Normal Output/Reverse Output

When in the Reset mode, and the counter value reaches the value of a preset, the related transistor output turns on. This is considered Normal Output operation. If the transistor output is reversed, it turns off when the counter value reaches the preset value.

The relay outputs have both normally open and normally closed contacts. When the control is in the Normal Output mode and the relay coils are wired to Outputs 1 and 2, each relay is deenergized until its associated preset is reached. If the Reverse Output mode is selected, the relay operates so the normally closed contacts are held open and the normally open contacts are held closed until the preset is reached.



WARNING

A POWER OUTAGE CAUSES THE TRANSISTOR OUTPUTS TO TURN OFF REGARDLESS OF THE OPERATING MODE SELECTED. BE SURE THAT THIS EFFECT IS NOT HAZARDOUS TO THE OPERATOR.

To select Normal or Reverse output operation, specify Function 33 and enter "0", "1", "2" or "3" for the desired combination of Normal and Reversed outputs. See Figure 22.

NOTE:

For ease of understanding, the following paragraphs presume normal output operation and show Reverse operation within brackets. For example, stating that Transistor Output 1 turns ON [OFF] at the preset 1 value indicates that it turns ON in the Normal mode and OFF in the Reverse mode.

Using the Crop Input

The outputs may also be turned ON [OFF] by energizing the Crop Input. This allows an external signal to energize any combination of the outputs as though the counter has reached the preset(s). See the "CROP INPUT OPERATION" section on page 35.

Turning The Outputs OFF [ON]

Next, determine what should cause each transistor output to turn OFF [ON] after reaching the related preset value. Several choices exist:

1. Timeout Function

First, the Timeout Function may be utilized. If the transistor output should turn OFF [ON] after a time delay, specify the length of the time delay for the Timeout Function. Use Function 30 for Transistor Output 1 and Function 31 for Transistor Output 2. If a timeout is NOT to be utilized, ensure that the value programmed for Function 30 and/or Function 31 is 0.00, which disables the Timeout Function for each output.

2. Unlatch Input

Second, each transistor output may be turned OFF [ON] by energizing an Unlatch Input. Typically, this is the result of an operator action. There are separate unlatch inputs for outputs 1 and 2. For either output, the Timeout and the Unlatch Input may both be used. In this case, whichever occurs first causes the transistor output to turn OFF [ON].

3. Unlatch at Reset

The third choice is the Unlatch at Reset operation mode. When this mode is enabled by entering a value in Function 39, either or both of the transistor outputs turn OFF [ON] whenever the "RESET" key is pressed or the Reset input is energized. A value of "1" in Function 39 allows output 1 to UAR, "2" allows output 2 to UAR and "3" allows both. "0" disables the UAR mode.

4. Latch Until Reset Complete

The fourth choice for turning OFF [ON] the transistor outputs is the Latch Until Reset Complete operation mode. If this mode is enabled by entering a value in Function 36, either or both of the transistor outputs turn OFF [ON] whenever the "RESET" key is released or the Reset Input is deenergized. A value of "1" in Function 36 allows output 1 to LURC, a value of "2" allows output 2 to LURC and "3" allows both. "0" disables the LURC mode.

5. Unlatch at Alternate Preset

Fifth, each transistor output may be turned OFF [ON] at the moment the counter reaches the other preset.

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That is; Transistor Output 1 automatically unlatches when Preset 2 is reached and/or Transistor Output 2 automatically unlatches when Preset 1 is reached. A value of "1" entered in Function 35 causes the counter to unlatch Output 1 at Preset 2. A value of "2" causes Output 2 to unlatch at Preset 1. "3" causes both Output 1 to unlatch at Preset 2 and Output 2 to unlatch at Preset 1. A value of "0" disables the Unlatch at Alternate Preset mode.

If the Unlatch at Reset, the Latch Until Reset Complete, or the Unlatch At Alternate Preset mode is selected, it usually implies that the Timeout Functions are not utilized. However, the Unlatch Inputs may still be used to turn OFF [ON] the related relays and transistor outputs without resetting the counter.

Auto Recycle

Should the control automatically reset to zero when one or the other preset values is reached? If so, Function 81 allows selection of which preset(s) causes Auto Recycle. A value of "1" allows Auto Recycle whenever the counter reaches Preset 1, "2" allows Auto Recycle for Preset 2, and "3" allows auto recycle to occur in either case. "0" disables the Auto Recycle mode.

Note that the Auto Recycle mode has no effect on the transistor outputs. To turn the transistor outputs OFF [ON] when the Auto Recycle mode is selected, the Timeout Function must be programmed, the Unlatch Inputs must be energized or (if either Unlatch At Reset or the Latch Until Reset Complete mode is selected) the "RESET" key pressed or Reset Input energized.

Reset Input Operating Mode

The next decision involves the manner in which the control responds to the "RESET" key being pressed or the Reset Input being energized. If the Maintained mode is selected (entering "0" in Function 82), the counter is held at zero as long as the key is pressed or the input is energized. When the key is released or the input deenergized, the counter is allowed to accumulate counts normally. If the Unlatch at Reset mode is selected, the specified combination of transistor outputs turn OFF [ON] when the "RESET" key is pressed or the Reset Input is energized. If the Latch Until Reset Complete mode is selected, the specified combination of transistor outputs turn

OFF [ON] when the key is released or the input deenergized.

If the Momentary mode is selected (entering "1" in Function 82), the counter is instantaneously reset to zero when the "RESET" key is pressed or the Reset Input is energized. Then the counter can accumulate counts normally regardless of whether the key or input is maintained or not. The counter is not reset again until the key is released and pressed again or the input is deenergized and energized again. If the Unlatch at Reset mode or the Latch Until Reset Complete mode is selected, the specified combination of transistor outputs turn OFF [ON] at the moment the key is pressed or the input is energized.

Disabling the Front Panel Reset Key

Select the Momentary Reset mode (enter "1" in Function 82) and install a jumper from the reset input (terminal 17) to DC Common. This disables the Front Panel Reset Key and prevents the operator from accidentally resetting the counter.

The jumper may be replaced by a normally closed contact. In this case, the counter is reset externally by opening and closing this contact. If power is interrupted, the counter is not reset when power is reapplied.

To continue programming, skip "PRESET MODE OPERATION", following, and proceed on to "BATCH COUNTER OPERATION" section on page 34.

Preset Mode Operation

Normal Output/Reverse Output

When in the Preset mode and the counter value reaches either Preset 1 or the value of zero, the related transistor output turns on. This is considered Normal Output operation. If the transistor output is reversed, it turns off when the counter value respectively reaches Preset 1 or zero.

The relay outputs have both normally open and normally closed contacts. When the control is in the Normal Output mode and the relay coils are wired to Outputs 1 and 2, each relay is deenergized until Preset 1 for Output 1 or zero for output is reached. If the Reverse Output mode is selected, the relay operates such that the normally closed contacts are held open and the normally open

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contacts are held closed until Preset 1 or zero is reached.



WARNING

A POWER OUTAGE CAUSES THE TRANSISTOR OUTPUTS TO TURN OFF REGARDLESS OF THE OPERATING MODE SELECTED. BE SURE THAT THIS EFFECT IS NOT HAZARDOUS TO THE OPERATOR.

To select Normal or Reversed outputs, specify Function 33 and enter a "0", "1", "2" or "3" for the desired combination of Normal and Reversed outputs. See Figure 22.

NOTE:

For ease of understanding, the following paragraphs presume Normal Output operation and show Reverse operation within brackets. For example, stating that transistor output 2 turns ON [OFF] at zero indicates that it turns ON in the Normal mode and OFF in the Reverse mode.

Using the Crop Input

The outputs may also be turned ON [OFF] by energizing the Crop Input. This allows an external signal to energize any combination of the outputs as though the counter has reached the preset(s). See the "CROP INPUT OPERATION" section on page 35.

Turning the Batch Output OFF [ON]

Next, determine what should cause the Batch Output to turn OFF [ON] after the Batch Counter has reached the Batch Preset. Several choices exist:

1. Timeout Function

First, the Timeout Function may be utilized. If the Batch Output should turn OFF [ON] after a time delay, specify the time delay for the Batch Timeout Function, Function 32. If a Timeout is NOT to be utilized, ensure that the value programmed for Function 32 is 0.00, which disables the Batch Timeout Functions.

2. Unlatch Function Code

Second, the Batch Output may be turned OFF [ON] by selecting a Function code and changing its value via the keyboard. If Function 71 is selected and a value of "1" is entered, the Batch Output immediately turns OFF [ON]. Once the control has unlatched the output, Function 71 automatically returns to a value of zero. This can be determined by reselecting Function 71 for interrogation.

3. Unlatch At Reset

The third choice is the Unlatch At Reset (UAR) operation mode. When this mode is enabled for the Batch Output by entering a value of "1" in Function 75, the output turns OFF [ON] whenever the "RESET" key is pressed or the Reset input is energized. Entering a "0" in Function 75 disables the Batch UAR mode.

4. Latch Until Reset Complete

The fourth choice for turning OFF [ON] the Batch Output is the Latch Until Reset Complete (LURC) operation mode. If this mode is enabled by entering a value of "1" in Function 73, the Batch Output turns OFF [ON] whenever the "RESET" key is released or the Reset Input is deenergized. Entering a "0" in Function 73 disables the Batch LURC mode.

Resetting the Batch Counter

The next decision involves the manner in which the Batch Counter is reset. In all cases, whenever the Batch Counter reaches the Batch Preset value it automatically resets to zero at the same time the Batch Output is turned ON [OFF]. However, it may be desired to reset the Batch Counter at other times. Two choices exist:

1. Batch Counter Reset Function Code

The Batch Counter may be reset manually through the keyboard using a Function code. If a value of "1" is entered in Function 70, the Batch Counter is immediately reset. Once the Batch Counter is reset, the control automatically returns Function 70 to a value of "0". This can be determined by reselecting Function 70 for interrogation.

2. Reset Batch Counter at Reset

The second choice is the Reset Batch Counter at Reset mode. When this mode is enabled by entering

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a value of “1” in Function 74, the Batch Counter is reset whenever the “RESET” key is pressed or the Reset Input is energized. Entering a “0” in Function 74 disables the Reset Batch Counter at Reset mode.

Crop Input Operation

The Crop Input may be used to simulate the effect of the counter reaching one or both of the Preset values. Primarily, this means that a selected combination of outputs are turned ON [OFF] when the Crop Input is energized. In addition, if other functions such as Auto Recycle or Unlatch At Alternate Preset are selected, they are also implemented as though one or both of the Presets had been reached by the counter. Note that the Crop Input does not change the value of the counter in order to cause the simulation. It only causes the response in the control as though the counter value reached the selected Preset values.

If one or more outputs are turned ON [OFF] by the Crop Input they must be turned OFF [ON] by a timeout, an Unlatch Input, or an Unlatch At Reset or Latch Until Reset Complete Function.

Using the Crop Input for Outputs 1 and 2

When the Crop Input is energized, any combination of outputs 1 and/or 2 may be turned ON [OFF]. A value is entered in Function 77 to select which Preset or Presets the Crop input simulates. An entry of “1” specifies Preset 1 and thus Output 1, an entry of “2”, Preset 2 and Output 2, and “3” specifies both. Entering a “0” in Function 77 specifies that neither Preset is simulated and therefore neither Output 1 nor 2 is turned ON [OFF].

The simulation of reaching a Preset value allows whatever functions selected to occur at that Preset to take place. This includes not only the activation of the related output, but also related Functions such as Auto Recycle and Unlatch At Alternate Preset. For example, if Function 81 (Auto Recycle) has a value of “2” (selecting Auto Recycle at Preset 2) and Function 77 also has a value of “2” (causing Crop Output 2) then the counter Auto Recycles in addition to turning Output 2 ON [OFF] whenever the Crop Input is energized.

Similarly, if the Unlatch At Alternate Preset mode (Function 35) has a value of “1” (selecting Unlatch

Output 1 at Preset 2) and Function 77 selects Crop Output 2, then Output 1 is Unlatched whenever the Crop Input is energized. Note that the Crop mode overrides the Unlatch At Alternate Preset mode. Thus, if Output 1 is also selected in Function 77 in this example, Function 35 causes Output 1 to turn OFF [ON] but Function 77 causes Output 1 to turn ON [OFF] when the Crop Input is energized. The net result is that Output 1 remains ON [OFF].

Using the Crop Input for the Batch Output

The Batch output may be selected to Crop by using Function 76, Batch Output Crop Mode. If a “1” is entered in Function 76, the Batch Output is turned ON [OFF] whenever the Crop Input is energized. Unlike Outputs 1 and 2, selecting the Batch Output Crop mode does not simulate reaching the Batch Preset. It only allows the Batch Output to be energized. Therefore, the value of the Batch Counter remains unaffected by the Crop Input. If the Batch Output is not required to turn ON [OFF] when the Crop Input is energized, enter a “0” in Function 76.

Reset at Crop

If the Crop Input is used, should the counter be reset at the same time that the outputs selected in Functions 76 and 77 are energized? Selecting the Reset At Crop mode by entering a “1” in Function 79 allows the Crop Input to reset the counter in addition to turning the outputs ON [OFF]. In this mode, the “RESET” key or the Reset Input may still be used to reset the counter without affecting the outputs. If the Reset At Crop mode is not desired, enter a “0” in Function 79.

Using the Reset At Crop function allows the counter to be reset at the same time that the specified combination of outputs are turned ON [OFF]. This is useful for “leading edge” resynchronization when a continuous roll or coil of material is loaded into the machine or process. However, the counter is reset only if Function 77 has a value of “1”, “2” or “3”. If it has a value of “0”, the Reset At Crop mode is ignored and the counter is not reset when the Crop Input is energized, even though Function 79 has a value of “1”. It is therefore not possible to simultaneously energize ONLY the Batch Output and reset the counter without energizing either one or both of Outputs 1 or 2.

SCALE FACTORS

NOTICE: This section applies only to Model 5884-1400, which has the Scaling ability. For Model 5884-0400, which does not have Scaling, this section should be ignored.

The Model 5884-1400 Control includes the ability to scale incoming counts. This means that for each pulse received on the count inputs, a fraction or multiple of that pulse is counted. Scaling can be used to compensate for wear on measuring wheels, consistent material slippage or material stretch, to

make conversions between different units of measure (inches to centimeters, for example) or to totalize parts produced from multiple part manufacturing processes (such as 6 parts produced for each operation of a press).

The scale factor can be a number from 0.0001 to 9.9999. This number becomes a factor by which incoming count pulses are multiplied. The sum of the scaled count pulses is shown on the front panel display.

SCALE FACTOR	COUNT SPEED (PULSES PER SECOND)	
	Normal Count	Quadrature and/or Doubled Count
0.0001 to 0.9999	5,000	2,500
1.0000	7,500	3,750
1.0001 to 1.9999	4,000	2,000
2.0000	6,000	3,000
2.0001 to 2.9999	3,500	1,750
3.0000	5,000	2,500
3.0001 to 3.9999	3,000	1,500
4.0000	4,000	2,000
4.0001 to 4.9999	2,750	1,375
5.0000	3,500	1,750
5.0001 to 5.9999	2,500	1,250
6.0000	3,000	1,500
6.0001 to 6.9999	2,250	1,125
7.0000	2,500	1,250
7.0001 to 7.9999	2,000	1,000
8.0000	2,250	1,125
8.0001 to 8.9999	1,750	875
9.0000	2,000	1,000
9.0001 to 9.9999	1,500	750

Figure 23. Table of Scale Factors versus Count Speed

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ENTERING A SCALE FACTOR

Function 5 selects the Scale Factor. Note that any jumper connected to the Program Inhibit terminal on the rear panel of the counter must first be disconnected before the Scale Factor may be modified. To change the Scale Factor, follow these steps:

1. Press the "FUNCTION" key. The display blanks to indicate that the key has been pressed.
2. Press the "5" key. The display indicates this digit.
3. Press the "ENTER" key. The current value for the Scale Factor is displayed. If the value does not need to be changed, proceed on to step 6 below.
4. Press the digit keys for the desired entry. Note that for a Scale Factor of 1 the entry of 10000 must be made since the scale factor is displayed in the X.XXXX format. The display shows the value as each key is pressed.
5. Press the "ENTER" key to store the new data. The display blanks momentarily as the control stores the information. If a zero is entered as the Scale Factor, the counter defaults to the value of 1.0000.
6. The next function to be interrogated or modified may be specified. If no additional functions need to be selected, the counter may be returned to displaying the current count value by pressing the "COUNT" key.

COUNT SPEED VERSUS SCALE FACTOR

The scale factor entered into the counter has a direct effect on the maximum rate at which the counter can receive count pulses. Generally, the larger the scale factor the slower the counter can receive pulses. A table indicating count speed versus scale factor values is given in Figure 23.

In this table, the Normal Count columns represent the speed at which the counter can receive pulses when it is operating in the Add/Subtract, Count with Direction Control or Count Up with Inhibit Control modes. The Quadrature and Doubled Count columns indicated speed whenever the hardware doubling (jumper installed between the Double Input and DC Common) is utilized.

OPERATION OF THE SCALER

When the counter receives a count pulse, the scaler recognizes that fact and multiplies the 1 pulse by the scale factor. The scaled value, which will be a number from 0.0001 to 9.9999 since this is the range of the scale factor, is added to a resultant total. This resultant is shown on the display. However, the result can have up to four decimal places of value. The display only shows whole increments of counts.

For example, a scale factor of 1.2000 is entered into the counter. For each pulse received, 1.2000 is added to the result. But since the display only indicates whole numbers, after the first pulse it shows "1". After 5 pulses it shows "6". This is shown in Figure 24.

PULSES RECEIVED	RESULT CALCULATED	DISPLAY VALUE
0	0.0000	0
1	1.2000	1
2	2.4000	2
3	3.6000	3
4	4.8000	4
5	6.0000	6
6	7.2000	7
7	8.4000	8
8	9.6000	9
9	10.8000	10
10	12.0000	12

Figure 24. Pulses Received versus Displayed Value Using Scale Factor of 1.2000

The scaler stores any remaining partial count and adds that to the next scaled pulse value when it is received. This allows accumulation of scaled partial counts.

When a Preset is established on a control with scaling, the control activates the related output when the displayed count value reaches the preset value. But when scaling is used, the count value is not necessarily a whole number. The partial count remainder can affect when the output(s) change state.

With the example of Figure 24, a Preset of 11 is entered into the control. After the first pulse the

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display shows 1 and after the ninth pulse it shows 10. But, the next pulse changes the display to show 12, bypassing the preset of 11. The counter, during the process of adding the scaled result to the total, actually counts from 10 through 11 to 12. This occurs so swiftly that the value of 11 cannot be seen on the display. However, the counter does recognize coincidence at the value of 11 and changes the state of the output.

As a second example, a Scale Factor of 0.5000 is entered into the control. Figure 25 gives a table of pulses received versus displayed value for this example.

PULSES RECEIVED	RESULT CALCULATED	DISPLAY VALUE
0	0.0000	0
1	0.5000	0
2	1.0000	1
3	1.5000	1
4	2.0000	2
5	2.5000	2
6	3.0000	3
7	3.5000	3
8	4.0000	4
9	4.5000	4
10	5.0000	5
11	5.5000	5
12	6.0000	6
13	6.5000	6
14	7.0000	7
15	7.5000	7
16	8.0000	8

Figure 25. Pulses Received versus Displayed Value Using Scale Factor of 1.2000

A Preset of 5 is entered into the control. From Figure 25 it is evident that the output will turn on when the 10th pulse is received on the count input. It is when the 10th pulse is received that the display changes from 4 to 5. However, if the counter is used in the Reset to Preset mode, the display shows 5 when the Reset key is pressed. The first pulse received changes the display to show 4, and the ninth pulse changes the display to 0. But, it is the TENTH pulse that causes the output to change state. This is because after the ninth pulse, there is a remainder of 0.5000 counts in the counter and, therefore, the

value in the counter is not actually zero until after the next pulse.

HOW SCALE FACTORS AFFECT PROCESSES

When the use of Scale Factors results in partial count remainders, those remainders can affect the manner in which the process being controlled will function. For example if a Scale Factor of 1.3000 is entered into a control and a Preset of 15 is utilized, a table as shown in Figure 26 results.

The control is used in the Reset mode. When reset, the counter starts at zero and counts to the Preset value. If the Auto Recycle mode is implemented, the counter recycles when the Preset value is reached. But, with a Preset of 15, the counter has actually accumulated 15.6000 counts. Thus, when it recycles, a value of 0.6000 counts remains. When the next pulse is received, 1.3000 counts are added and the count value is 1.9000. The "Second Cycle Display" column shows the displayed value for the second cycle.

It is obvious from the last column that slightly more counts are accumulated for the second part than were accumulated for the first. If this table were carried out for the third part, we would find that the third part is cut off one pulse too early. Clearly, the carryover of the remaining partial count causes problems in these types of applications.

As a solution, a function code has been provided which allows the choice of whether the remaining partial count is carried over into the next cycle or not. Function 83, Scaler Reset on Recycle, allows selection of this option. If Function 83 has a value of "0" entered, the scaler is not reset when an Auto Recycle occurs. If a value of "1" is entered, the scaler is reset each time an Auto Recycle occurs. This forces any remaining partial count to be reset to zero, eliminating the problem described above. The unit is shipped from the factory with the Scaler Reset on Recycle Mode enabled (Function 83 has a value of "1").

It should be noted that the remaining partial count is typically an extremely small part of the total length of the part being produced (typically less than 1%). In those applications where the measurement system may be chosen, the rule of thumb is that the measurement device should have a minimum of

SCALE FACTORS

twice the resolution (generate at least twice as many pulses per unit of measure) as the desired part accuracy.

For example, if a 10.00 inch part is to be made and the tolerance of the part may be plus or minus 0.02 inches, the measurement system should generate at least one pulse for each 0.01 inches of material being measured. Thus, after the display shows 10.00 inches (1000 counts), there may be a remaining partial count of 0.400 due to the use of a Scale Factor. The percentage of error is calculated by $0.400/1000$. This yields 0.04% error.

Even though the error is so small, compensation should still be made for the extra partial count at the end of a part by entering a "1" in Function 83. This is because the error is cumulative; that is, each successive part grows longer by 0.004 inches. Eventually, this cumulative error will cause the part to be out of tolerance.

Typically, those applications which require Function 83 to have a value of "1" are cut-to-length applications. When the application is performing a repetitive process such as punching equally spaced holes in a single part, the scaler should retain partial counts for the next measurement. In these cases, Function 83 should be set to "0".

Whenever the Reset key is pressed or the Reset Input is energized, the scaler is always reset, eliminating any remaining partial counts. This is regardless of the value entered in Function 83.

CALCULATING THE SCALE FACTOR

There are four general categories of applications which require scaling. The method of calculating the scale factor differs for each. The categories are:

1. Allowances for wear of measurement devices and material stretch applications.
2. Unit conversions (Typically when the measurement system is set up for measuring in one unit and the part must be made in another; i.e., inches versus millimeters.)
3. Scaling of pulses received from flowmeters or other sensors which produce a non-standard number of pulses per unit of measure.
4. Allowing multiple parts to be made for each operation of a machine.

A discussion of the means of calculating the scale factor for each category and special problems involved follows.

Allowances for Wear or Stretch

Over a period of time a measuring wheel will begin to wear. The wheel allows accurate measurement only when its circumference is a known, fixed value. Thus, as the wheel wears, the error in the measurement increases because the circumference of the wheel becomes less and less. Scaling provides a means to compensate for the decreasing wheel circumference. This allows the useful life of

PULSES RECEIVED	RESULT CALCULATED	DISPLAY VALUE	SECOND CYCLE RESULT	SECOND CYCLE DISPLAY
1	1.3000	1	1.9000	1
2	2.6000	2	3.2000	3
3	3.9000	3	4.5000	4
4	5.2000	5	5.8000	5
5	6.5000	6	7.1000	7
6	7.8000	7	8.4000	8
7	9.1000	9	9.7000	9
8	10.4000	10	11.0000	11
9	11.7000	11	12.3000	12
10	13.0000	13	13.6000	13
11	14.3000	14	14.9000	14
12	15.6000	15	16.2000	16

Figure 26. Pulses Received versus Display Value Using Scale Factor of 1.3000

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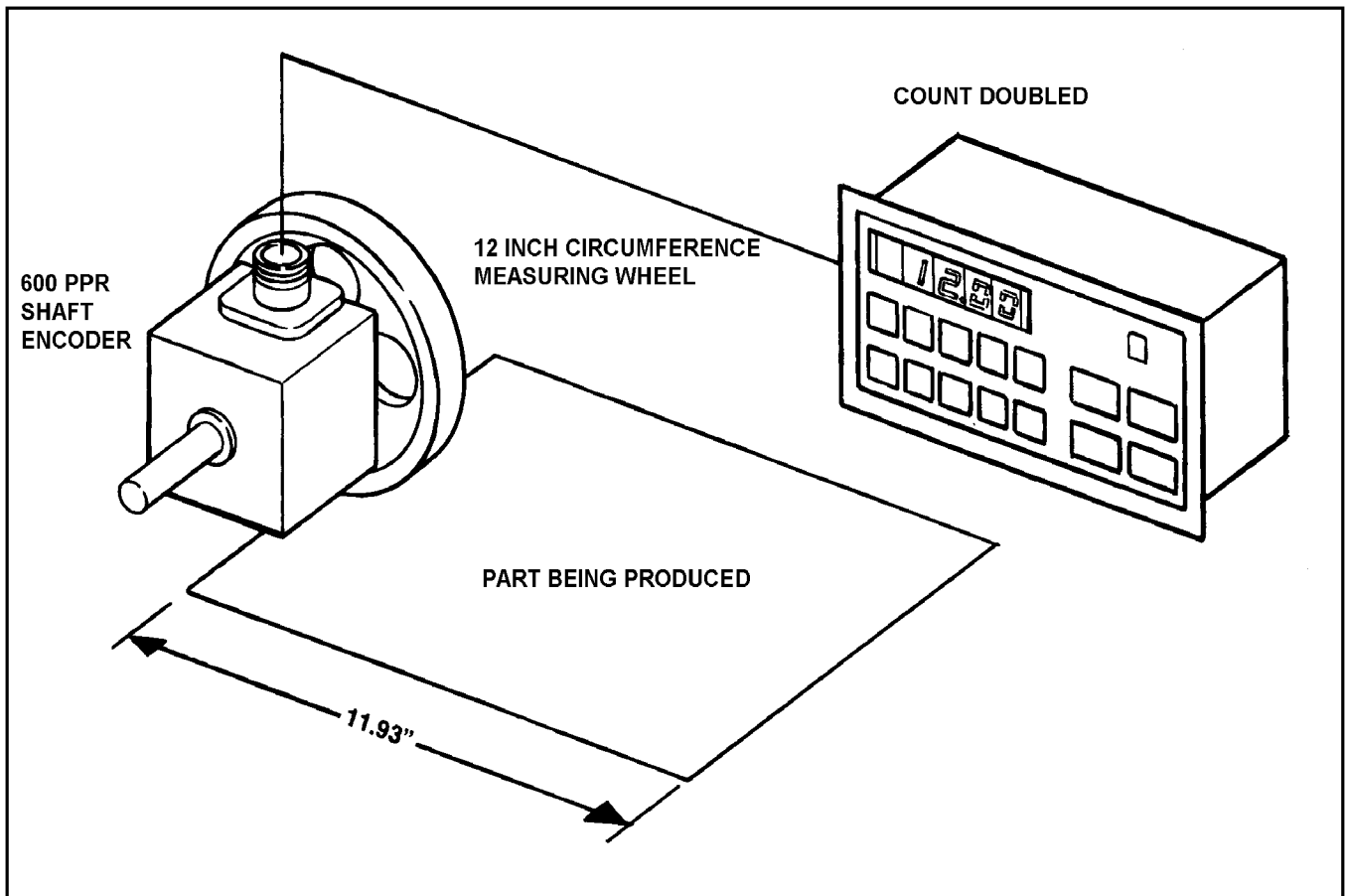


Figure 27. Wheel Wear Correction Application

the measuring wheel to be extended, decreasing cost.

In applications where the material stretches or shrinks by a fixed amount, scaling allows compensation for gained or lost material. These applications required that the amount of stretch or shrinkage be known, measurable or calculable and that it be consistent from machine cycle to machine cycle.

In either case, the scale factor is calculated by using the formula:

$$\text{Scale Factor} = \frac{\text{Measured or Calculated Distance}}{\text{Theoretical Distance}}$$

In the above formula, the Theoretical Distance is the distance that would be measured if the measuring wheel were new or within design tolerance of new. For stretch or shrinkage

applications, it is the amount of material fed into the process before the stretching or shrinkage occurs.

The Measured or Calculated Distance is the length which results upon completion of the part or process.

For example, if the counter is intended to produce 12.00 inch parts but the parts come out of the machine only 11.93 inches long, the Measure Distance is 11.93 inches. (The Theoretical Distance in this example is 12.00 inches.) Figure 27 shows graphically what takes place in this application.

The shaft encoder in Figure 27 produces 600 pulses per revolution. Doubling is used in the counter to result in 1200 pulses per revolution. The measurement wheel is intended to have a 12.00 inch circumference. This should result in 1 pulse per 0.01 inches. Since a 12.00 inch is desired, a Preset of 1200 is entered into the counter with a scale factor of 1.0000.

SCALE FACTORS

However, when the process is run, the parts consistently come out of the machine only 11.93 inches long. The counter is counting 1200 pulses and the output of the counter is energized at that time. Obviously, the wheel is not the 12.00 inch circumference which it should be. Rather than replacing the measurement wheel, a scale factor can be entered to compensate for the discrepancy. Using the formula on the previous page, the scale factor is calculated by:

$$\text{Scale Factor} = \frac{11.93'' \text{ (Measured)}}{12.00'' \text{ (Theoretical)}} = 0.9942$$

With this scale factor entered, the display still shows 12.00 counts for each part, but each pulse received is worth only 0.9942 counts. Thus, more than 1200 pulses are received by the counter for each part being produced and the part is made to the correct length.

For applications where the material is stretched or shrunk, the measurement device may be located on the front end of the process where the unaffected material is fed in. Yet the counter can have a scale factor entered which allows it to measure the finished parts. Figure 28 shows a typical process which results in material stretch.

Again, a 12.00 inch part is desired. A Preset of 12.00 is entered into the control with a scale factor of 1.0000 and a sample part is produced. When it is measured, it is found to be 12.37 inches long. The scale factor needed to produce a 12.00 inch part is calculated by plugging these values into the formula:

$$\text{Scale Factor} = \frac{12.37'' \text{ (Measured)}}{12.00'' \text{ (Desired)}} = 1.0308$$

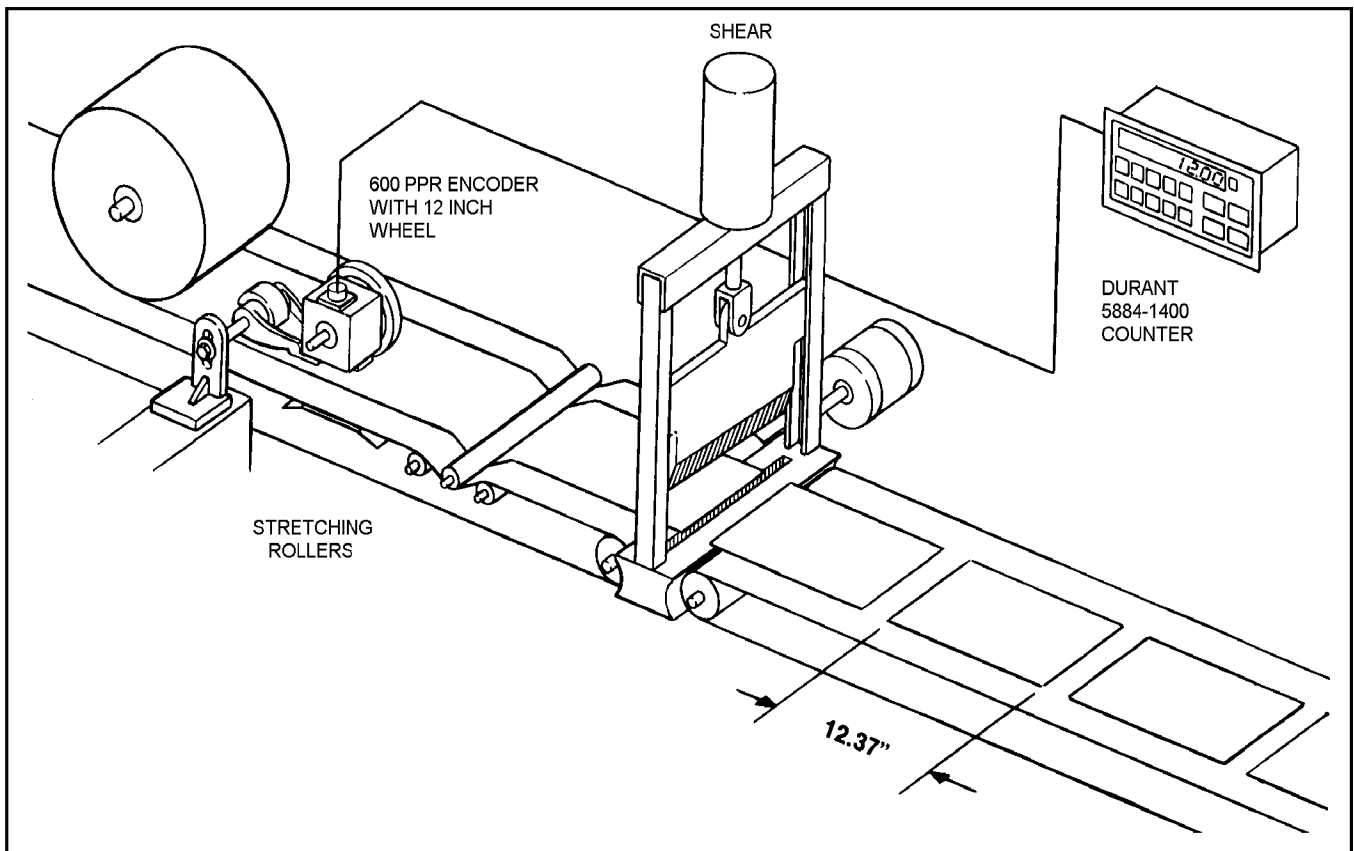


Figure 28. Material Stretch Application

SCALE FACTORS

When the scale factor of 1.0308 is entered into the control, parts are produced at 12.00 inches as desired. Since the material is stretched in the process, each pulse received by the counter is worth 1.0308 counts. Thus, less than 1200 pulses need to be received to produce each 12.00 inch finished part and display 1200 counts.

Unit Conversions

In some cases, the measurement system is set up to measure in one engineering unit but the parts made are produced in a different engineering unit. This may be the difference between ounces and gallons, inches and feet, feet and yards, inches and millimeters, quarts and liters or any other combination. In these applications, the scale factor may be chosen from the table given in Figure 29 or calculated using any standard conversion factor carried out to four decimal places.

Scaling Pulses Received From Flowmeters or Other Sensors

Typically, flowmeters generate large numbers of pulses for each unit of measure. Additionally, the number of pulses per unit is usually not easily divisible or massaged to allow a standard counter to increment in a common engineering unit.

MEASUREMENT SYSTEM MEASURES IN:	DISPLAY MUST SHOW QUANTITY IN:	SCALE FACTOR TO BE USED:
Inches	Centimeters	2.5400
Centimeters	Inches	0.3937
Feet	Yards	0.3333
Yards	Feet	3.0000
Feet	Meters	0.3048
Yards	Meters	0.9144
Meters	Feet	3.2808
Meters	Yards	1.0936
Gallons (US)	Liters	3.7854
Galons (Imp.)	Liters	4.5428
Liters	Gallons (US)	0.2642
Liters	Gallons (Imp.)	0.2201
Quarts (US)	Liters	0.9463
Liters	Quarts (US)	1.0567

Figure 29. Unit Conversion Scale Factors

The scale factor to be entered into the counter is easily calculated by using the formula:

$$\text{Scale Factor} = \frac{1 \text{ (Unit of Measure)}}{\text{Pulses Produced per Unit of Measure}}$$

For example, a flowmeter might produce 146 pulses per gallon of flow. If the counter is to count gallons of flow, the incoming pulses must be divided by 146. If the display should indicate whole gallons of flow accumulated, the scale factor is determined by:

$$\text{Scale Factor} = 1 / 146 = 0.0068$$

If the display should rather show gallons and tenths of gallons, the scale factor may be multiplied by 10 to yield 0.0685. (Note that in this case the decimal point on the counter should be placed between the first and second digits for proper indication of units.)

When the output from other sensors must be scaled, the same formula can be used to calculate the scale factor. It is sometimes easier to change the definition of the terms in order to find the scale factor, however. For example, a quadrature shaft encoder which produces 600 pulses per revolution is used to indicate rotation of a shaft. Usually, rotation is given in degrees with 360 degrees per revolution. If the doubled Quadrature count mode is used, 1200 pulses per revolution are received by the counter. This results in 3.3333 pulses per degree of rotation.

Given this information, finding the scale factor necessary for proper operation can be confusing. But if the terms of the formula are changed as:

$$\text{Scale Factor} = \frac{\text{Desired Display Value}}{\text{Actual Pulses Received}}$$

Filling in the terms the scale factor is found by:

$$\text{Scale Factor} = \frac{360(\text{Counts Per Revolution})}{1200(\text{Pulses Per Revolution})} = 0.3000$$

With the Scale Factor of 0.3000, the display will indicate 360 degrees per revolution from a 1200 PPR encoder.

SCALE FACTORS

Allowing Multiple Parts per Machine Operation

If a single machine operation causes one pulse to be received by the counter and that single machine operation produces several parts simultaneously, the scale factor is simply the number of parts produced per pulse. For example, if six parts are produced per cycle of the machine, a scale factor of 6.0000 should be entered into the control.

In this example, if one of the six cavities requires repair and is not producing parts, the scale factor may be reduced from 6.0000 to 5.0000. This adjustment can be made without resetting the counter. The machine must be stopped, the Program Inhibit jumper removed if installed, and the Scale Factor changed. Then the Program Inhibit jumper may be reinstalled and the process started

up again. This allows in-process service and adjustment of machine malfunctions without losing track of how many parts have been produced so far.

It may be desirable in this type of application to have the Program Inhibit terminal wired to a key-lock switch, allowing easier adjustment when needed.

An additional consideration in this application is that even if the Preset is set as a multiple of six and only five parts are made per cycle, the Preset does not need to be adjusted. This is true because the counter checks the preset for each of the five increments per cycle individually and will energize the output when coincidence is established. However, in this example, up to four extra parts may be produced when the output is energized.

SERIAL COMMUNICATIONS

Several types of information may be transmitted or received by the control. The serial communications capability allows the count value, either preset value or any combination to be printed, remotely displayed, or sent to a host computer or other peripheral device for processing. The characteristics of the communication are controlled by function codes.

COMMUNICATION FORMAT

The control uses a **20 milliamp current loop** type of electrical interface for serial communications. The control has a separate 20 milliamp current loop for incoming communications and another loop for outgoing communications.

Since serial communication (either in or out) is done through only two wires, each character transmitted or received must be generated by a series of on and off states called bits. Each character has its own unique code or sequence of bits that allows the receiving device to understand what character it is receiving. The character "5", for example, has a series of bits which are different from the series of bits for the character "6". In fact, eight individual bits are needed to express a single character. **Seven bits** identify the character itself and the eighth is used for error checking to allow the receiving device to make sure that the previous seven are correct when they are received. This eighth bit is called the parity bit and shows "**even parity**" to the receiving device when transmitting data. When the counter is receiving serial data, it ignores the parity bit.

There are several different standard rates at which serial communications occur. Each is a function of the number of bits transmitted per second. The term which defines transmission rate is "Baud," which is understood to mean "bits per second."

The standard transmission rates the control can be set up to use are **110 Baud, 300 Baud, and 1200 Baud**.

While each character requires eight individual bits to be uniquely expressed, a few additional bits must be sent between characters. These are called "start" and "stop" bits. The "**start**" bit signifies that this is the beginning of the character and the next eight bits are the character itself. After the character is transmitted, either **one or two "stop" bits** are sent to indicate that the character has been completely transmitted. When the control is operating at 110 Baud, two "stop" bits are sent and at 300 or 1200

Baud one is sent. Thus, at 300 Baud, for example, each character requires ten bits to be transmitted: one "start" bit, eight data bits and one "stop" bit. If information is being communicated at 300 Baud, 30 characters per second are communicated since a total of ten bits per character are required.

The standard set of codes used by the control for communicating information serially is called the **ASCII** character table. **ASCII** stands for American Standard Code for Information Interchange. The control uses **ASCII** codes for all its communications.

A typical character transmitted or received is shown in Figure 30. In this figure, the character is shown with the "start" bit, seven data bits, the even parity bit, and one "stop" bit.

SENDING DATA

Data transmission can be initiated by either of two methods. The first is by connecting the PRINT REQUEST terminal (terminal #16) to DC Common. The second is by a special code transmitted to the control via the serial communications.

Once a transmission has been initiated, the counter will first transmit the "Carriage Return" and "Line Feed" characters (described in the following paragraphs and illustrated in Figure 31) followed by the numeric information selected for printing. The "Carriage Return" and "Line Feed" characters cause the printer to provide spacing between printouts.

When the control transmits the actual value or either preset value through the SERIAL DATA OUTPUT (SDO) terminals, it sends the characters "0" through "9" as necessary to express the value. It transmits the most significant digit (**MSD**) first. For example, if the current value of the counter is 13578, the control sends the ASCII code for "0" since the most significant digit is blank and has a value of zero, then the code for "1", then the code for "3", then "5", then "7", and finally "8".

After the entire value has been transmitted, the control sends two more characters. These are called "Carriage Return" (CR) and "Line Feed" (LF). A printer, host computer or other peripheral uses these characters to identify when a transmission is complete. In the case of the printer, the "CR" instructs it to return the printing carriage and the "LF" tells it to advance the paper one line. The "**CR**" and "**LF**" are transmitted after each value the control sends.

SERIAL COMMUNICATIONS

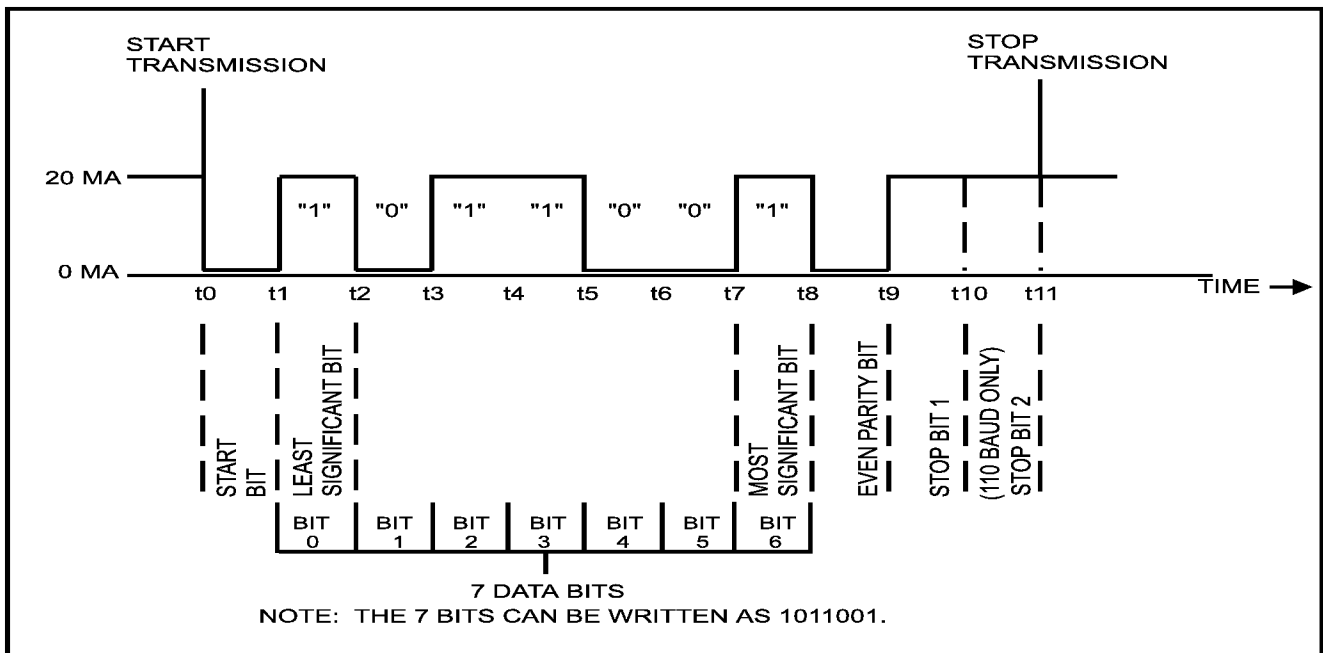


Figure 30. Organization of Typical Serially Transmitted Character

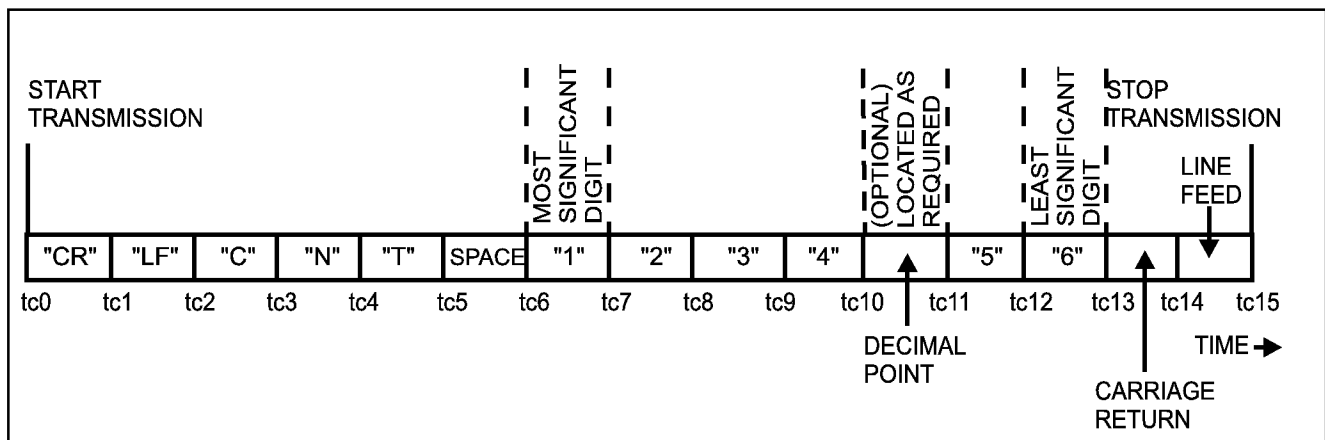


Figure 31. Serial Transmission of a Complete Value, Including "CNT" Label, Value, "CR" and "LF"

By selecting the associated value for the Communications Type function (Function 91) the control can transmit any combination of the counter value, either preset value, the batch count value and/or the batch preset. Before the value(s) are sent, the control sends an identifier which indicates what information is to follow. When the control is connected to a printer, these identifiers are also printed. The label "CNT" is printed before the value of the counter, "PS1" is printed before the Preset 1 value and "PS2" is printed before the Preset 2 value.

If a decimal point has been specified by programming Function 62, the decimal point is inserted into the printout at the appropriate place.

For the Batch count value the label "BTC" is printed and "PS3" is printed before the Batch Preset. No decimal point is printed for these values.

Figure 31 shows graphically how a typical value is transmitted. Each block shown consists of the bit organization as indicated in Figure 30.

SERIAL COMMUNICATIONS

CNT	1234.56
PS1	5000.00
PS2	9738.15
BTC	004601
PS3	005000

Figure 32. Typical Printout of Transmitted Values

Figure 32 shows sample printout when the control has been set up to print all of the values with a decimal point before the second digit.

If the count value and both preset values are to be transmitted, the count value is always transmitted first, Preset 1 second and Preset 2 third.

If the Batch Count and Batch Preset values are to be sent, the Batch Count is sent before the Batch Preset.

The control can be programmed to automatically transmit its values when reset. This mode is selected by entering a "1" in Function 92. Upon pressing the "RESET" key or having the Reset input energized, the control internally stores the count value, then resets the counter. Once the control is reset, the stored count value is transmitted. This allows the count value to be recorded while the process is running without losing any counts. For proper operation, the count value must be allowed to be transmitted by entering a value of "0", "1", "4" or "5" as the second digit in Function 91.

When the Print on Reset mode is selected, the Print Request input may be energized or the ASCII "?" received through serial communication to cause a printout without resetting the counter.

RECEIVING DATA

The control can receive a command through the serial communications input which instructs it to automatically transmit the information of the counter or presets (depending on Function 91). This command has the same effect as energizing the Print Request input. The ASCII character "?" asks the control to send its data.

In addition, the value of either preset or the Batch Preset can be changed through the serial communication input when a new value is received from a remote preset peripheral, a host computer or another compatible peripheral. The new Preset 1 value must be preceded by the ASCII character "A" which informs the control that a new Preset 1 value is forthcoming. The ASCII character "B" must precede the new Preset 2 value, and an ASCII "C" must precede a Batch Preset value. After the 1 to 6 digits for the new preset are received, the ASCII character "*" must be received to tell the control that the end of the preset value has been received. When the "*" is received, a new preset is automatically entered.

Sample commands to change both Preset 1 and Preset 2 via serial communications is shown in Figure 33. Note that each block shown contains the bit organization as indicated in Figure 30. A

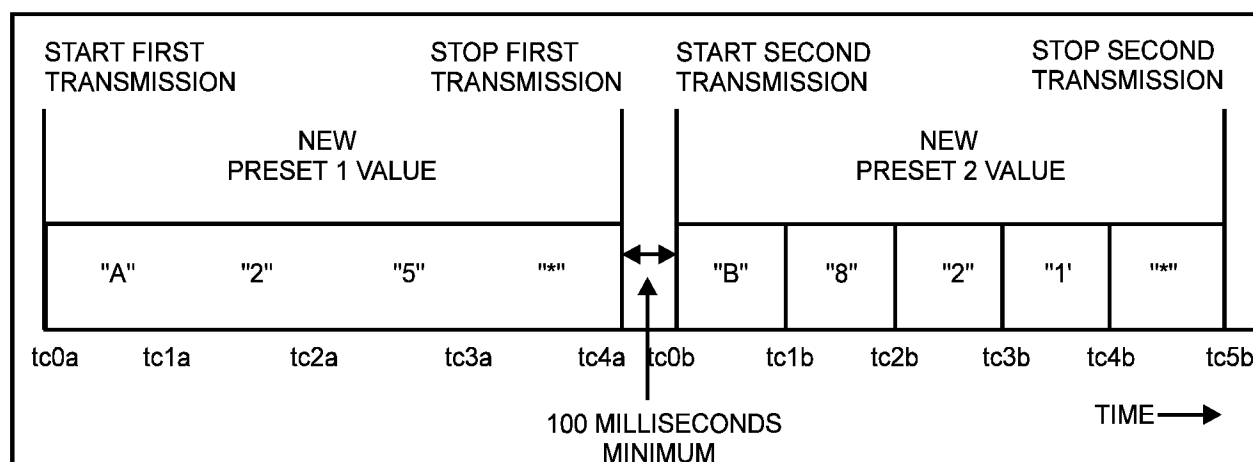


Figure 33. Typical Preset Change Serially Communicated

SERIAL COMMUNICATIONS

minimum of 100 milliseconds must be allowed between transmissions for proper operation.

The Baud rate of the incoming serial communications is the same rate as set for the outgoing communications. Any serial data the control receives is ignored if it is not either preceded by an "A", "B", "C" or a "?". The control ignores any decimal points which are received during a transmission of a new preset, but inserts the decimal point automatically after the new preset has been entered upon receipt of the "*".

Function 91 Value (Two digit value, "XY")	COUNT	PRESET 1	PRESET 2
"Y" value			
0	✓	✓	✓
1	✓		✓
2		✓	✓
3			✓
4	✓	✓	
5	✓		
6		✓	
7	(No Transmission Allowed)		
"X" value	BATCH COUNT	BATCH PRESET	
0	✓	✓	
1		✓	
2	✓		
3	(No Transmission Allowed)		

Figure 34. Function 91 codes for the 5884-0400

SERIAL COMMUNICATIONS SET-UP

Communications Speed

If the control is to communicate to or from another device, it must be set up to do so. The first question is: What speed of communication is required by the other device? There are three possible answers acceptable: 110 Baud, 300 Baud, and 1200 Baud. One of these three speeds should be chosen based on the capabilities of the other transmitting or receiving device. For example, if the Durant President printer is to be receiving information from the control, 1200 Baud should be selected by entering a value of "2" in Function 90. Note that the President printer must also be set up to receive at this rate.

If one of the several standard 5880 series peripherals is connected, see the Installation/Operation manuals for these devices to determine the necessary communication speed setting.

Communication Type

If the control is to transmit information to a receiving device, the second question is: what information does the receiving device need to know? The control allows one of 32 answers. The current count value, either preset value, the Batch Count value, the Batch Preset value, or any combination may be transmitted. Enter a value in Function 91 to select according to the table in Figure 34.

Selection is made by combining one of the 7 possible values for "Y" above with one of the 3 possible values for "X". For example, if the Batch Count and the current Count value are to be printed, the entry for

FUNCTION 91 Value "XY" (Two Digit Entry)

"X" VALUE	BATCH PRESET	BATCH COUNT	SCALE FACTOR	"Y" VALUE	COUNT	PRESET 1	PRESET 2
0	✓	✓	✓	0	✓	✓	✓
1	✓		✓	1	✓		✓
2		✓	✓	2		✓	✓
3			✓	3			✓
4	✓	✓		4	✓	✓	
5	✓			5	✓		
6		✓		6		✓	
7	(No Transmission Allowed)			7	(No Transmission Allowed)		

Figure 35. Function 91 codes for the 5884-1400

SERIAL COMMUNICATIONS

Function 91 is "25". If all values should be printed, enter a "00".

Transmitting Scale Factors

For Model 5884-1400, the Scale Factor can be transmitted with the other values when a printout is generated. Function 91, Communicating Type is enhanced in the 5884-1400 to provide transmission control of the Scale Factor. Figure 35 shows the selection values for Function 91 in the model 5884-1400. Use this table to select which of the values will be transmitted.

CNT	001567	(Count Value)
PS1	010000	(Preset 1 Value)
PS2	025000	(Preset 2 Value)
BTC	000000	(Batch Count)
PS3	000000	(Batch Preset)
SCA	1.0000	(Scale Factor)

Figure 36. Sample Printout of Values from a 5884-1400

When the Scale Factor is printed, the value is preceded by the identifying label "SCA", indicating Scale Factor. A sample printout of all values from a model 5885-1400 control is given in Figure 36.

Receiving Scale Factors

A Scale Factor can also be sent to one of these controls through serial communications. In this case, the Scale Factor must be preceded by an ASCII "S". The Scale Factor itself can be up to five digits long in ASCII characters and followed by an ASCII "**". For example, a Scale Factor of 5.0000 is transmitted as "S50000**".

Print On Reset

The third question concerning serial communication is: when the control is reset, should it also print? If the control should automatically print when reset, enter a value of "1" in Function 92, to select Print On Reset mode. If a printout is not desired when the control is reset, enter a "0" in Function 92.

APPLICATION EXAMPLES

This section provides several typical applications for the control. Each gives a description of the process, details how the process works, and indicates which features are utilized to satisfy the requirements. Where necessary, a sketch and/or wiring diagram is also provided.

MATERIAL CUT-TO-LENGTH APPLICATION

Description

Material dispensed from a continuous roll must be cut to a length adjustable by the operator. The material is dispensed and stopped before it is cut. In order to make the length of the part accurate, the material is dispensed at two speeds. The fast speed is used to feed most of the length in as short of a time as possible. The slow speed allows the material to be slowed down and creep up to the stopping point. This prevents over travel of the material and insures that it is cut at the desired dimension.

The cut sheets are stacked at the end of the first conveyor. The number of sheets per stack must be controlled. When a stack is complete, the second conveyor must be indexed.

Operation

Due to inertia of the material and drive motor, a certain amount of material is dispensed whenever a changeover is made from high to low speed. This is a function of the mechanical devices involved and cannot be controlled by the counter. Thus, when a desired length of part is to be produced, the motor must be switched from high to low speed at least this amount before the material should come to rest in order to prevent the part from becoming too long. The point at which the speed must change is called the "slow-down" point.

The material is measured with a shaft encoder generating 600 pulses per revolution and a measurement wheel with a 12 inch circumference. This combination results in 1 pulse per .02" of material. Since the material starts and stops, a quadrature encoder is used. This prevents the counter from receiving false counts due to material jitter or vibration when it is at rest.

In this application, the slow-down point must occur at least 2 inches before the stopping point. The shear requires a signal with a duration of at least 500 milliseconds to complete its operation. The

counter must be reset at the same time the shear is energized to allow the next part to be measured accurately.

Each time a part is made, the Batch counter in the control is incremented. The Batch counter keeps track of how many parts have been made. When the Batch counter reaches a specific number, it turns on the Batch output and automatically resets for the next stack.

A sketch of this application is given in Figure 37.

Set-up

Since a Quadrature encoder is used and the incoming counts must be doubled, the Doubled Quadrature count mode is used. This is selected by entering a value of "3" in Function 60. The decimal point should be located to allow the display to show increments of .01 inches. Thus, a value of 2 is entered in Function 62.

The length of the part changes; however, the slowdown point is always 2 inches less than the length of the part. In this case, it may be easier for the operator to change only the total length desired and allow the control to have a constant number entered for the slow-down point. If the Reset to Preset mode is selected, the counter can be reset to Preset 2 upon the completion of a part. Then the counter can count down toward zero as the material is dispensed. Preset 1 is programmed to have a value of 2.00 or 2 inches. When the counter reaches the preset 1 value, Output 1 turns on, slowing down the motor, and dispensing the final two inches at low speed. Reset to Preset operation is selected by entering a value of "1" in Function 80.

Output 2 turns on when the counter reaches zero. This output should timeout to fire the shear. The time value is set to 500 milliseconds by entering a value of "50" in Function 31, Output 2 Timeout Operation. Output 1 should turn on when the counter reaches the Preset 1 value and turn off when the counter reaches zero. This means that the Unlatch at Alternate Preset mode is required for Output 1. Entering a value of "1" in Function 35 allows Output 1 to unlatch when the counter reaches zero (effectively the Preset 2 value when the counter is in the Reset to Preset mode). Both outputs should operate normally (not reversed), so a value of "0" is entered in Function 33 (Output Status Operation).

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No timeout is desired for Output 1 so a value of "0" is entered in Function 30. Neither Unlatch at Reset nor Latch Until Reset Complete mode is needed so a value of "0" is entered in both Functions 36 and 39 to disable these options.

When the counter reaches zero, it should automatically reset to preset to start the next part. Thus the Auto Recycle operation is selected by entering a value of "2" in Function 81. This allows the counter to recycle when the value of zero is reached (effectively Preset 2 in Reset to Preset mode). The Reset key or input may be used to reset the counter and either Maintained or Momentary mode may be selected. Therefore, Function 82 (Reset Input Operating Mode) is left unchanged.

Since the counter is operating in the Reset to Preset mode, the Batch counter increments automatically whenever zero is reached. The Batch output should energize whenever the Batch counter reaches the Batch Preset. This is considered Normal Batch Output operation. Thus, a value of "0" is entered in Function 72, Batch Output Operating Mode. Since the second conveyor requires a 100 millisecond pulse to cause it to index, the Batch output should

remain energized for that amount of time. The Batch Timeout, Function 32, is set to 0.10 seconds. Neither the Batch Output LURC or the UAR is required, so a value of "0" is entered in both Functions 73 and 75. Since the Batch Counter should not be reset with the Reset key, a "0" is also entered in Function 74.

The Crop Input of the counter may be used to remove a visually detected bad piece of material from the conveyor or to remove an inspection sample. In this case the Crop input should activate the shear and simultaneously reset the counter. The Batch output should remain unenergized since the second conveyor should not be indexed at this time. A "0" is entered in Function 76 to insure that the Batch output is not energized via the Crop Input. Since output 2 energizes the shear, a "2" is entered in Function 77 to allow output 2 to be energized when the Crop Input is energized. The Reset on Crop function is desired, thus Function 79 has a value of "1" entered into it.

No serial communication is necessary so Functions 90, 91 and 92 are left unchanged.

Wiring for this application is shown in Figure 38.

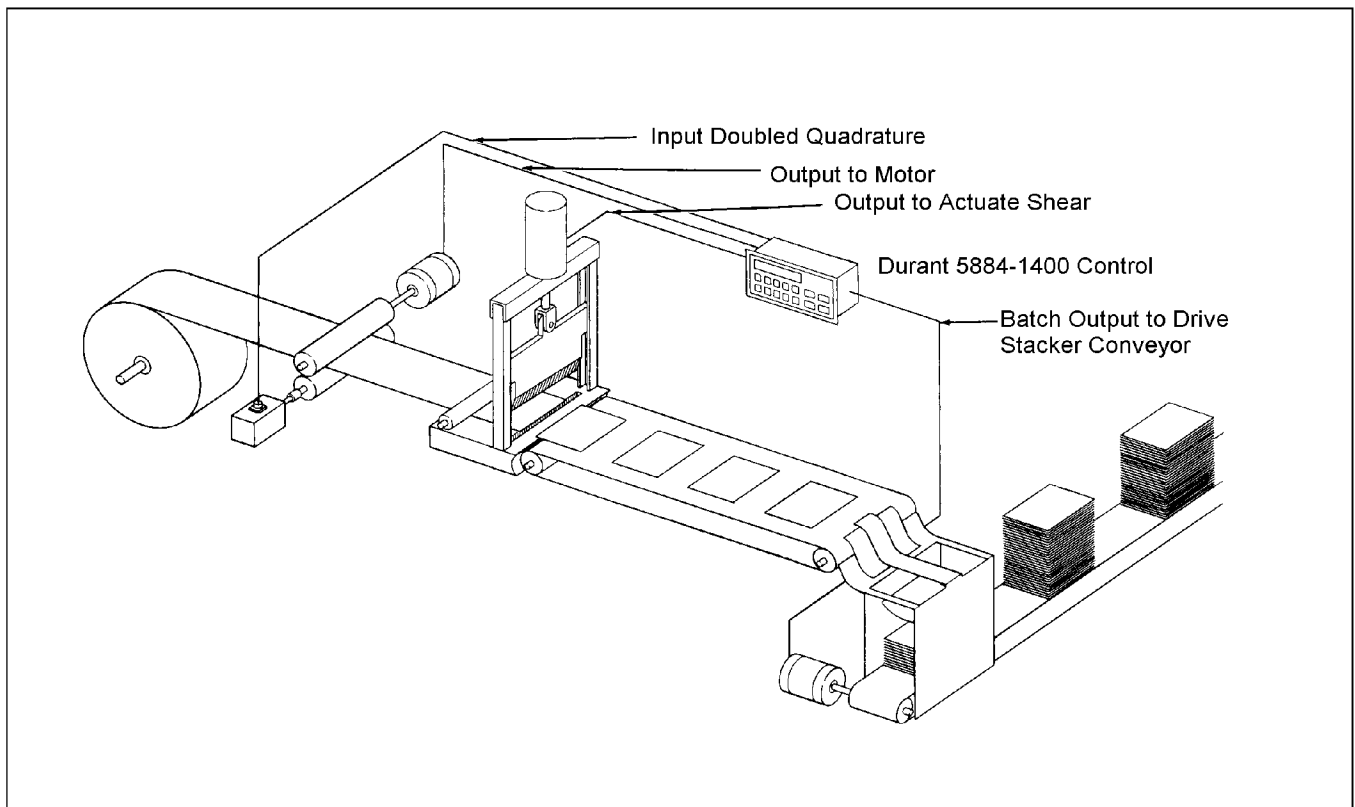


Figure 37. Cut-To-Length and Stack Application

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DISPENSATION OF BULK FLUID

Description

Bulk fluid must be dispensed into shipping containers. The liquid is dispensed at two speeds to allow production to be at its maximum. Most of the fluid is measured into the container at a high volume and the rest is allowed to trickle to top off the container.

The containers are brought under the dispensation spout on a conveyor. When a container has been completely filled, the conveyor is indexed. As the next empty container is moved under the spout, it blocks a photosensor which starts the dispensation.

Filled cans are packaged 6 to a carton. Since they are covered and packed by hand, an operator must place each can in the carton. The filling valves should be prevented from dispensing fluid after each set of 6 cans so that the operator has time to close the carton, seal it and prepare the next empty carton. The operator will press a switch to indicate that the new carton is ready.

Operation

The counter is reset when the container is located under the spout via the photoelectric sensor. Then both outputs turn on, energizing two solenoid valves, allowing the fluid to be dispensed. The fluid is measured by a flowmeter which is calibrated to provide 1 pulse for each ounce of liquid. Typical containers are one gallon cans (128 ounces). With these cans, the dispensation is slowed by turning off one of the valves for the last eight ounces. When 128 ounces have been dispensed, both valves are turned off and the counter waits until the next container is located before reopening the valves.

The Batch counter is used to count the number of cans produced. The Batch output turns on when a Preset of 6 is reached, energizing an external relay. Normally Closed contacts from this relay provide power to the solenoid valves. Thus, when the Batch has been completed, the relay is energized, removing power from the solenoid valves.

A sketch of this process is given in Figure 39.

Set-up

Since 128 ounces of fluid must be dispensed, a value of 128 is entered as Preset 2. The free-flow valve

must be turned off 8 ounces before that, thus a value of 120 is entered as Preset 1.

The flowmeter produces pulses when the valves are energized. The output of the flowmeter is connected to Count Input 2 of the counter. The Add/Subtract count mode is selected by entering a "0" in Function 60. Since measurement takes place in one ounce increments, no decimal point is needed so a "0" is entered in Function 62. The Reset mode is selected to allow the counter to start at zero and count up to Preset 2 by entering a "0" in Function 80. Auto Recycle is needed to prepare the counter for the next can once a can has been filled. Function 81 is programmed with a value of "2" to enable Auto Recycle.

Output 1 of the counter controls the free-flow valve and Output 2 controls the constricted flow valve and the conveyor. Relay K2 is operated by Preset 2 and has both Normally Open and Normally Closed contacts. The Normally Open contact energizes the constricted flow valve and the Normally Closed contact operates the conveyor. This allows the conveyor and flow to be mutually exclusive; that is, either one or the other may be operating at a time, but not both. This prevents accidental spillage.

When the photoelectric sensor detects that a can is present, both outputs should turn on, allowing full flow of the fluid and stopping the conveyor. This is Reverse Output operation and is selected by entering a "3" in Function 33. The outputs are individually turned off when the associated Presets are reached. To turn on the outputs with the photo sensor, the Unlatch Inputs are used. Since the outputs are reversed, the Unlatch Inputs turn on relays K1 and K2. Both of the valves should be turned on at the same time. Therefore the output of the photo sensor is wired in parallel to both of the Unlatch Inputs. No timeout is required for the outputs nor is Unlatch At Reset, Latch Until Reset Complete or Unlatch at Alternate Preset needed. "0" is entered in Functions 30, 31, 35, 36 and 39 to disable these functions.

The photoelectric sensor will be blocked at all times when a container is sitting before it. This means that the Unlatch Inputs are always energized during this time. This forces the outputs to remain unchanged even though the counter may reach one or both of the Presets. To allow the outputs to

APPLICATION EXAMPLES

operate properly, the sensor must generate a momentary pulse whenever the can comes into position rather than generating a continuous signal. A special “one-shot” version of the photoelectric sensor must be used. A sensor with a one-shot output produces a pulse of adjustable length each time the sensor becomes blocked. To operate in this application, the output time duration must be at least 10 milliseconds.

The Batch output turns on whenever the Batch counter reaches the Batch Preset. This is Normal Batch Output Operation and is selected by entering a “0” in Function 72. The Batch output should remain energized until an external contact from a control switch is closed. The external switch can be wired into the Reset Input of the control and the Batch Output can be Unlatched at Reset. This is selected by entering a value of “1” in Function 75. Batch

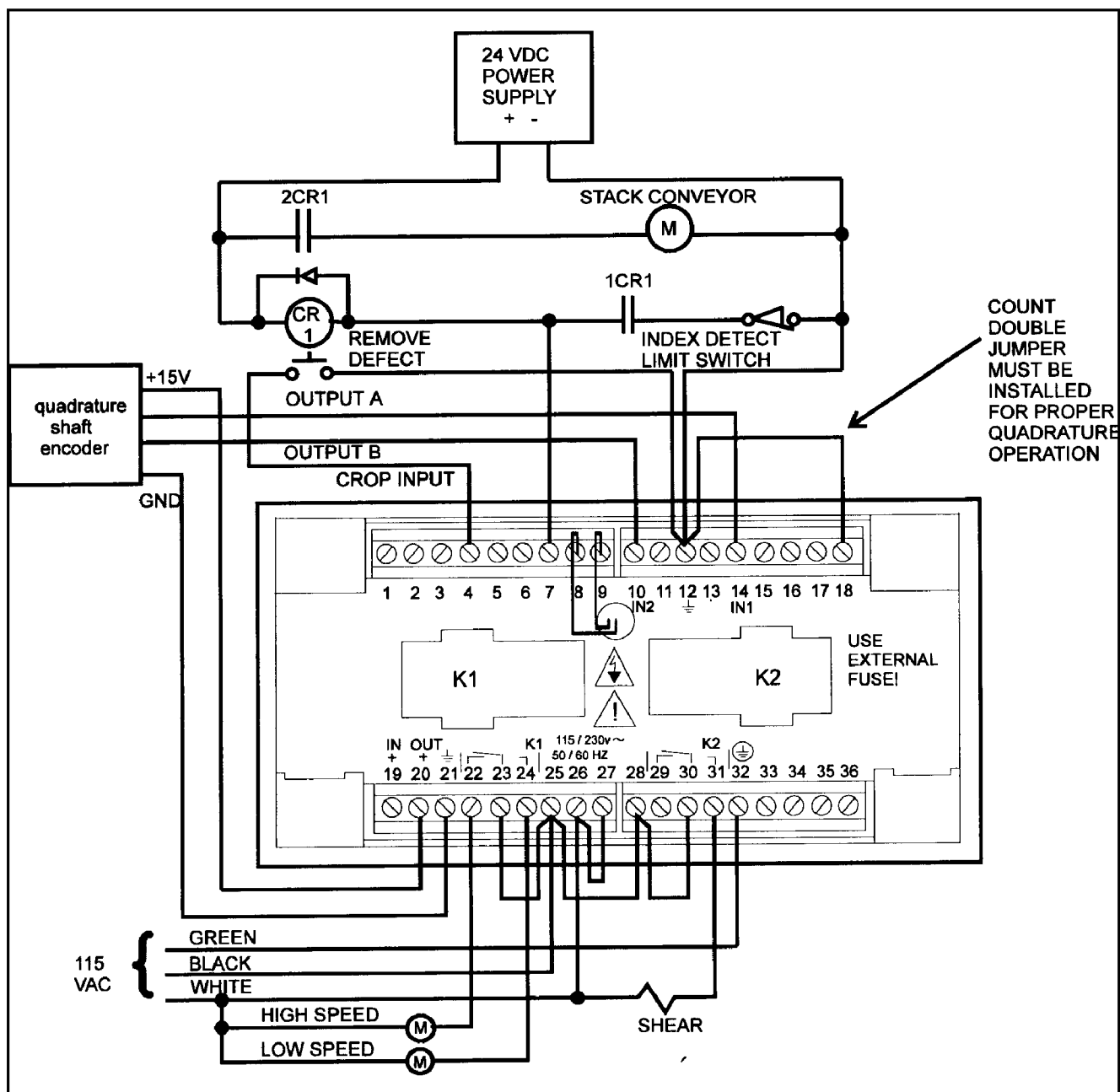


Figure 38. Schematic for Cut-To-Length and Stack Application

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LURC is not needed nor is Batch Output Crop mode. Thus "0" is entered in both Functions 73 and 76.

The Momentary mode is needed for the Reset Input since energizing the Reset Input allows fluid to begin being dispensed immediately. The counter must be allowed to count the pulses from the flowmeter even though the operator may still be pressing the switch. Therefore, the Momentary Reset mode is selected

by entering a value of "1" in Function 82. The Batch counter should not be reset when the Reset key is pressed or the Reset input energized, so a "0" is entered in Function 74, Batch Count Reset mode.

No communication is needed so Functions 90, 91 and 92 are left unchanged.

A schematic of the wiring for this application is given in Figure 40.

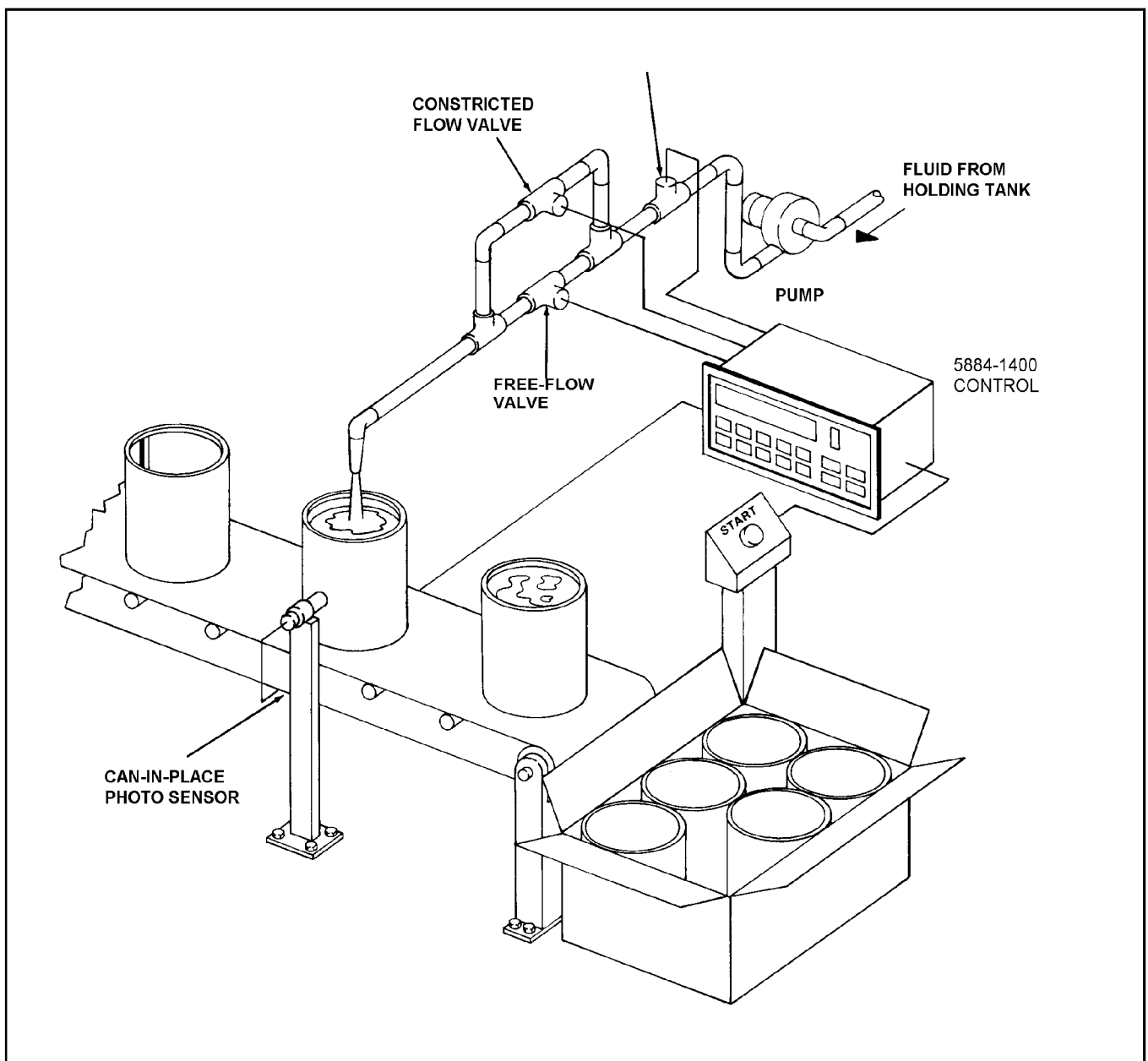


Figure 39. Fluid Dispensation and Batching Application

APPLICATION EXAMPLES

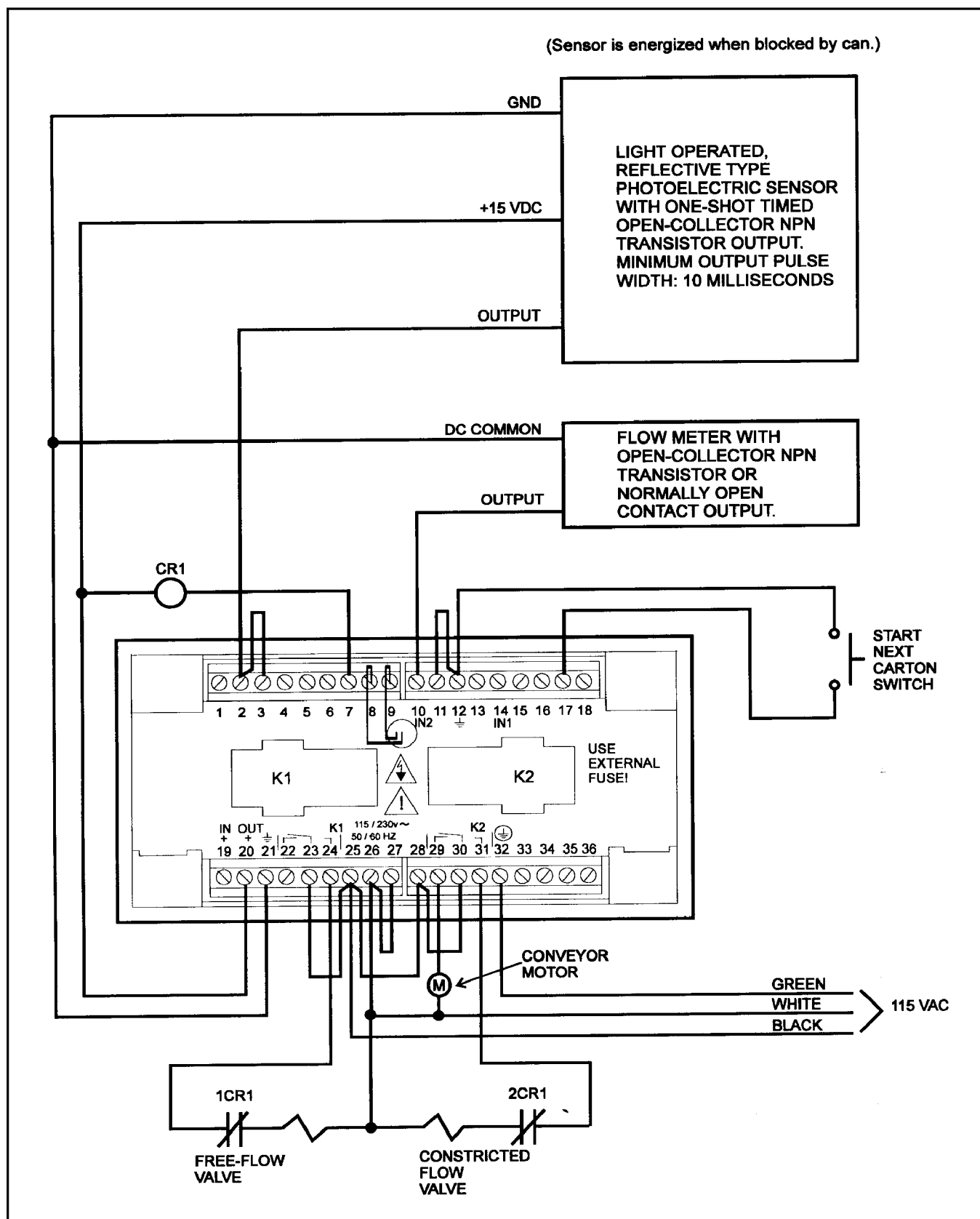


Figure 40. Schematic for Fluid Dispensation and Batching Application

TROUBLESHOOTING

GENERAL

Most problems encountered when applying the control are due to wiring errors, improperly set Function codes, and sensors which are not correctly installed. This section provides guidelines for the detection and correction of these types of problems. Additionally, a description of the diagnostic program included in the control is discussed.



CAUTION

BEFORE APPLYING POWER TO THE EQUIPMENT, RECHECK ALL WIRING TO INSURE PROPER CONNECTIONS. MAKE SURE THE AC LINE VOLTAGE IS CONNECTED ONLY TO SCREW TERMINALS #25, #26, #27 AND #28. CONNECTING AC POWER TO ANY OTHER SIGNAL TERMINALS WILL CAUSE SEVERE DAMAGE TO THE CONTROL.

PROBLEM	POSSIBLE CAUSES	REMEDIES
Display does not light when AC power is turned on.	<ol style="list-style-type: none"> 1. No power applied on terminals #25, #26, #27 and #28. 2. Terminals #25, #26, #27 and #28 are improperly jumpered. 3. Short between terminals #19 or #20 and DC Common. 	<ol style="list-style-type: none"> 1- Check wiring, fuses and primary AC power source. 2- Check jumper installation. 3- Immediately disconnect AC power supply, check wiring.
Counter does not increment or decrement when sensor is activated.	<ol style="list-style-type: none"> 1. Sensor malfunction, improperly installed or connected. 2. Incorrect count mode selected for type of sensor being used. 3. Reset input (terminal #17) connected to DC Common. 4. Low frequency select terminals (terminals #11 and #13) connected to DC Common when sensor generates count pulses less than 1 msec long. 	<ol style="list-style-type: none"> 1- Check sensor wiring, installation and operation. 2- Check function code diagram (Fig. 22) for proper value selection for Function 60. 3- Check wiring. 4- Disconnect low frequency terminals.

Figure 41. Troubleshooting

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	REMEDIES
Counter counts in wrong direction.	<ol style="list-style-type: none"> 1. Quadrature shaft encoder outputs A and B reversed. 2. Add and Subtract signals reversed. 3. Improper count mode selected for sensor configuration utilized. 4. Polarity of up/down control signal reversed when Count With Direction Control mode is selected. 	<ol style="list-style-type: none"> 1. Reverse wiring on inputs 1 and 2 (terminals #14 and #10). 2. Reverse wiring on inputs 1 and 2 (terminals #14 and #10). 3. Check Function Code diagram (Fig. 22) for proper value selection for Function 60. 4. Invert up/down control signal on terminal #10 with an external relay or transistor.
Counter accumulates too many counts.	<ol style="list-style-type: none"> 1. Electrical noise causing extra counts. 2. Loose wires between sensors and count inputs. 3. Sensor generating extra pulses due to vibration, oscillation, chatter or jitter. 	<ol style="list-style-type: none"> 1- a. Check sensor lead installation to insure they are not bundled with other power wiring. 1- b. Connect low frequency select terminals (terminals #11 and #13) to DC Common if pulses from the sensor are longer than 1 msec. 1c. Use shielded cable for wiring sensors to Count Inputs (terminals #10 and #14) and connect the shield to terminal #32. 2. Check external sensor wiring. 3. Check sensor mounting and motion of machine to determine if these characteristics cause extra count. Use Quadrature encoders where applicable.

Figure 41. Troubleshooting (continued)

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	REMEDIES
Counter misses preset 1.	Bypass preset 1 input is connected to DC Common.	Check wiring on terminal #1.
Counter counts to preset 1 and recycles.	Auto recycle mode is selected to auto recycle at preset 1.	Check entry at Function 81.
Relays and transistor outputs energize but do not deenergize.	No option selected to unlatch outputs.	Utilize unlatch inputs, Unlatch At Reset Mode, Latch Until Reset Complete mode, Unlatch At Alternate Preset mode, or Timeout mode.
Relays do not energize.	Relay coil leads on rear of counter are unconnected.	Connect the relay coil leads to the desired combination of terminals 5,6,7,8 and 9.
No printout or incorrect printout is generated when the control is connected to a printer.	<ol style="list-style-type: none"> 1. No AC power applied to printer. 2. Printer improperly set up. 3. Serial communications output incorrectly wired to printer. 4. Baud rates of control and printer not setup to the same value. 	<ol style="list-style-type: none"> 1. Check AC power connections and fuse in printer. 2. Check printer DIP switches for correct setup. (See Printer Installation Manual) 3. Check that SDO+ (terminal #35) on control is connected to SDI- on printer and SDO- (terminal #36) is connected to SDI+. 4. Check that the Baud rates of the control and the printer are the same.

Figure 41. Troubleshooting (Continued)

TROUBLESHOOTING

CHECK-OUT PROCEDURE

If the control does not perform satisfactorily, check all connections, proceed through the troubleshooting chart on the previous pages, and check all function codes for proper set-up according to the table given in Figure 22. If these tests proceed correctly and the control is still not properly functioning, remove ALL wiring from the back of the counter and proceed through the following steps. If the control fails to function in any of the steps return it to Durant Products, 901 South 12th Street, Watertown, WI 53094, Attention: Repair Department. Enclose a letter describing the malfunction.

Power Input

Connect 115 VAC between terminals #25 and #26. Jumper terminal #25 to terminal #28 and jumper terminal #26 to terminal #27. The display should flash for a short period of time and then remain lit. Place electrical tape over terminals #25 through #28 to prevent electrical shock during the next tests.

Connect the Gray lead on the rear of the control to terminal #9 and the White/Yellow lead to terminal #8.

Keyboard

Press the "FUNCTION" key, the display should blank. Press "43" which the display should indicate. Press ENTER, the display should show "0". Press "1" which the display should indicate. Press "ENTER", the display should flash "0" and the "COUNT" indicator for a short period of time then remain lit.

Count Up

Make a momentary connection between terminals #10 and #12. The display should increment several counts. Make a connection with a short piece of wire between terminals #11 and #12 and repeat the count test between terminals #10 and #12. Retain the connection between terminals #11 and #12.

Count Down

Make a momentary connection between terminals #14 and #12. The display should decrement several counts. Make a connection with a short piece of wire between terminals #13 and #12 and repeat the count test between terminals #14 and #12. Retain the connection between terminals #13 and #12. Decrement the counter until the display indicates less than "5".

Preset

Press the "PRESET 1" key and the display should show "0". Press the "5" key, which the display should indicate. Press the "ENTER" key. The display should blank for one half second then remain lit. Press the "COUNT" key, the display should indicate the previous count value. Make a momentary connection between terminals #10 and #12 at least five times. You should hear the output relay actuate.

Relay Timeout

Ten seconds after relay K1 actuates, you should hear it release.

Reset

Press the "RESET" key. The display should show "0".

Unlatch

Again make a momentary connection between terminals #10 and #12 at least five times. Before the ten second timeout elapses, make a momentary connection between terminals #2 and #8. You should hear output relay K1 release. Press the "RESET" key again.

Latch Until Reset Complete

Press the "FUNCTION" key, press "36", then press "ENTER". The display should indicate "0". Press the "1" key, then "ENTER". The display should show "1", blank for one half second then remain lit. Press the "FUNCTION" key, press 30, then press "ENTER". The display should show "10.00". Press the "0" key, then "ENTER". The display should show "0.00", blank for one half second then remain lit. Press the "COUNT" key, the display should indicate "0" and the COUNT indicator lit. Make a momentary connection between terminals #10 and #12 at least five times. You should hear the output relay activate. Press the "RESET" key. The display should display "0" and you should hear the relay release.

Auto Recycle

Press the "FUNCTION" key, press "81", then press "ENTER". The display should indicate "0". Press the "1" key, then "ENTER". The display should show "1", blank for one half second, then remain lit. Press the "COUNT" key, the display should indicate "0" and the COUNT indicator lit. Make a momentary connection between terminals #10 and #12 five

TROUBLESHOOTING

times. You should hear output relay K1 activate and the display should show "0".

Power Outage

Disconnect the AC power. You should hear relay K1 release.

INTERNAL DIAGNOSTICS

The control has several internal diagnostic routines which allow it to self-test various operational characteristics. When power is applied, the control tests its memory to determine if it has retained all of the values and function code parameters previously entered. It also tests to insure that all of the internal memory is functional. During these self-tests, the display is blanked. Since the tests are performed very quickly, the user usually does not notice the short delay on power-up.

The user also has the ability to initiate the control self-test diagnostics at any time. Function code 40 is used to initiate the diagnostics. If the control fails any of the diagnostic routines, either on power-up or upon manual command, the display will flash a number indicating which of the six self-tests failed. If no failures are found, the control returns automatically to normal operation.

NOTE

The self-diagnostics should not be performed while the process being controlled is running. The control responds to count pulses but ignores any incoming control signals while the diagnostics are operating.

Description Of The Diagnostics

The diagnostics which are included and their related test numbers are as follows:

- #1 - ROM (Read Only Memory) 16 Bit Checksum
- #2 - Internal RAM (Random Access Memory) Bit Test
- #3 - Non-Volatile RAM Read/Write Bit Test
- #4 - Non-Volatile RAM Store Test
- #5 - Non-Volatile RAM 8 Bit Checksum
- #6 - Watch Dog Timer (1.3 Seconds) Timeout

ROM (Read Only Memory) 16 Bit Checksum-Test #1

This test determines if the permanent memory which controls how the control operates is good.

Internal RAM (Random Access Memory) Bit Test-Test #2

This routine tests the temporary workspace memory used for normal operation and communication. If a failure occurs, the counter may change or lose values or operating characteristics unexpectedly.

Non-Volatile RAM Read/Write Bit Test-Test #3

This test checks the memory which permanently stores the operating characteristics and values when a power outage occurs.

Non-Volatile RAM Store Test - Test #4

This test insures that the non-volatile memory accurately stores and retrieves the programmed operating characteristics and values upon a power outage. If a failure of this type occurs, the counter will operate correctly but could change its values or operating characteristics upon a power failure or power drop-out.



CAUTION

TO INSURE PROPER OPERATION, CHECK ALL FUNCTION CODE VALUES BEFORE STARTING THE PROCESS. NOTE THAT A TEMPORARY POWER INTERRUPTION MAY CHANGE THE VALUES OF FUNCTION CODES DURING THE PROCESS IF TEST #4 HAS FAILED.

Non-Volatile RAM 8 Bit Checksum Test - Test #5

A checksum test is performed on the non-volatile memory to insure that none of the information stored was changed while the control was unpowered. If this test fails, check all function code values and the values of the counter and preset to insure they are correct. Then disconnect and reconnect power to perform this test again. If the test fails the second time, return the counter for repair.

TROUBLESHOOTING

Watch Dog Timer (1.3 Seconds) - Test #6

While the control is operating, an internal Watch Dog Timer is incremented every millisecond. Under normal operation, the control automatically resets the Watch Dog Timer at least once per second. If the control would malfunction during operation, the Watch Dog Timer may time out (depending on the type of malfunction) and an error code of "6" flashes on the display. If this type of failure occurs, run the diagnostics using Function 40. Excessive electrical interference may cause this type of failure without damage to the control or the operating characteristics. If the diagnostics find no other fault, it is reasonable to assume that the control is fully operational, unless this failure is recurring.

OPERATION OF DIAGNOSTICS

When power is applied, the control begins by performing tests #1, #2, #3 and #5. If all of these pass, the counter is ready to operate as indicated by flashing the count value on the display at one half second intervals for four seconds, then remaining lit.

To select the self-diagnostic mode, specify Function code 40 and enter a value of "1". The control immediately turns on all display segments and LED indicators for 2 seconds. Then the displays blank and the control steps through all five tests. If all five pass, the control begins a display and LED test routine.

This routine sequences through flashing the numbers "0" through "9" on the displays, alternates the Preset 1, Preset 2 and Count LED indicators and moving the decimal point from digit to digit. When the display sequence is finished, the control shows the count value and the Count indicator is lit.

NOTE

The self-diagnostics should not be performed while the process being controlled is running. The control responds to count pulses but ignores any incoming control signals while the diagnostics are operating.

Performing the diagnostic routines does not affect the Function code parameters. Thus, when the diagnostics are finished, the control retains all of the operational characteristics previously programmed.

WHAT TO DO IF THE CONTROL FAILS A DIAGNOSTIC TEST

If the control flashes a single digit number continuously on power-up or when the self-diagnostics are performed, it indicates which one of the tests has failed. When the number displayed is a "4", "5", or "6", the control can be allowed to operate by pressing the FUNCTION key to clear the display.



WARNING

RUNNING THE COUNTER AFTER A FAILURE HAS BEEN DETECTED CREATES A SERIOUS RISK TO THE OPERATOR AND/OR MACHINERY.

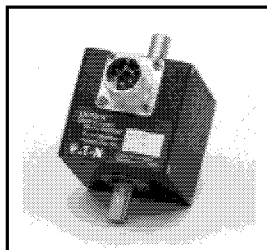
As a minimum safety precaution, the Function code Default mode (Function 43) should be selected (enter a value of "1") and the Function codes reprogrammed. This will insure that the failure has not altered any of the operating characteristics of the counter. Selecting the default parameters with Function 43 also performs the power-up self-test, which could give another failure indication (for tests #1, #2 or #3). If this occurs return the control for repair immediately.

Address units to be repaired to:

Durant Products
901 South 12th Street
Watertown, WI, 53094
ATTENTION: REPAIR DEPARTMENT

Enclose a letter describing the malfunction.

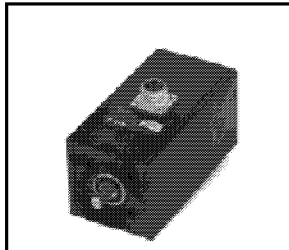
ACCESSORIES AND REPLACEMENT PARTS LISTS



Medium Duty Shaft Encoder

Single Channel--38150-XXX

Quadrature -- 38151-XXX

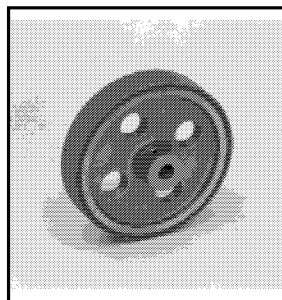


Heavy Duty Shaft Encoder

Single Channel--48370-XXX

Quadrature -- 48371-XXX

60, 100, 120 and 600 PPR are stocked ratios for encoders. Any number from 001 to 600 is available. Substitute the desired PPR for "XXX" in the part numbers.

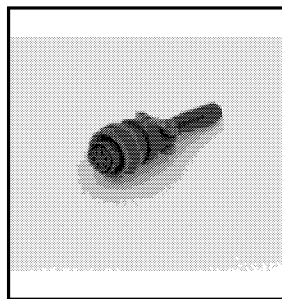


12" Measuring Wheels with 3/8" Bore

Aluminum Rimmed
20156-301

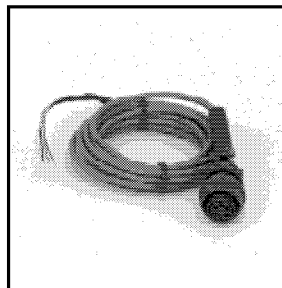
Rubber Rimmed
20154-301

Urethane Rimmed
20144-301



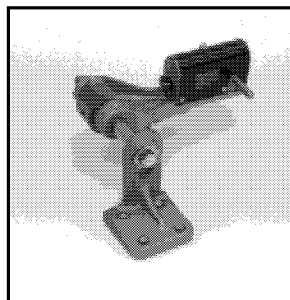
Connector for Encoder

29729-300



Connector with 10 Foot Cable

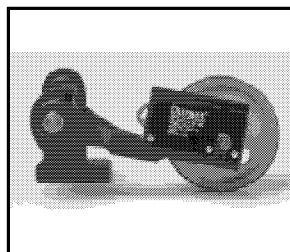
29665-300



Mounting Bracket for ES-9513-RS

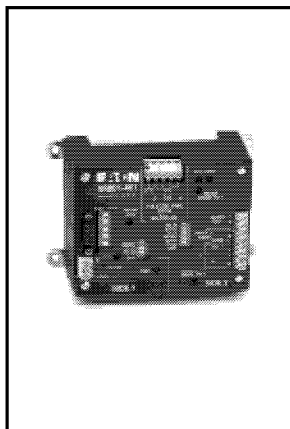
40460-400

Shown with ES-9513-RS and 12" measuring wheel



Rotary & Lineal Contactor

ES-9513-RS

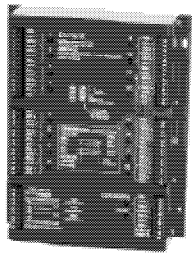


Communications Converter (20mA Loop to RS-232)

58801-460

The Communications Converter interfaces 20 mA current loop to RS-232 levels and allows full duplex operation. The unit has a self contained power supply which requires 120 VAC power.

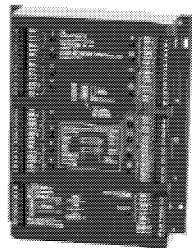
ACCESSORIES AND REPLACEMENT PARTS LISTS



Serial to Parallel BCD Communications Converter

58801-410

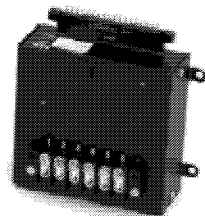
The Serial to Parallel BCD Communications Converter (SPCC) is a serial to parallel BCD adaptor which provides a means of interfacing a Durant counter to a ladder logic based Programmable Control. The SPCC converts the serial data from the counter's 20ma current loop to eight digits of binary coded decimal data for use by the Programmable Control. The BCD output is connected to the I/O structure of the PC. Several options, conveniently selected by a four position DIP switch, eliminates the need for a special configuration for each different application. The SPCC has a self contained power supply which requires 120VAC power.



Parallel BCD To Serial Communications Converter

58801-411

The Parallel BCD to Serial Communications Converter (PSCC) is a parallel BCD to serial adaptor which provides a means of interfacing a Durant counter with a ladder logic based Programmable Control. The PSCC converts eight digits of binary coded decimal data from a PC to serial data to be input to the Durant counter through the counter's 20ma current loop. The BCD input is connected from the I/O structure of the PC. Several options, conveniently selected by a four position DIP switch, eliminates the need for a special configuration for each different application. The PSCC has a self contained power supply which requires 120VAC power.



Simultaneous Input Processor

The Simultaneous Input Processor (SIP) is used as an accessory with Durant counters to insure that all counts are recorded when multiple sources of count signal are required (counts can occur simultaneously).

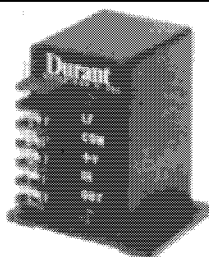
8 Input	49990-408
16 Input	49990-416



Timer Module

48160-440

The Durant Timer Module, 48160-440, provides a series of timed output pulses at a rate selectable by the user. The selection is made by setting a DIP switch located on the side of the module. A variety of pulse rates, from 1,000 pulses per second to 10 pulses per minute, can be set on the switch. The timer module will convert any Durant electronic counter or count control with a high speed (5000 Hertz) input into a timer.

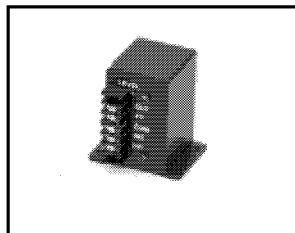


Divider Module

48160-420

The Durant Divider Module, 48160-420, makes it possible for two counters which would ordinarily require two different encoder ratios to be driven from the same encoders.

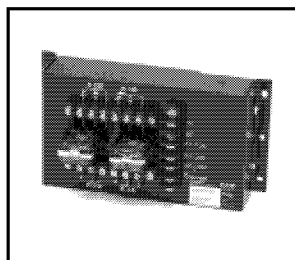
ACCESSORIES AND REPLACEMENT PARTS LISTS



Input Signal Conditioner

48160-400

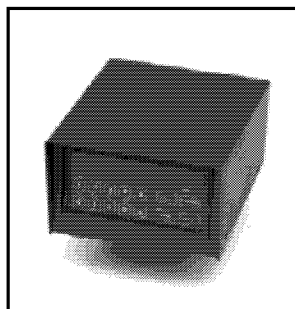
The Model 48160-400 Signal Conditioner converts a wide range of input signals to a level that is compatible with Durant Electronic Controls. It will accept differential inputs from 50 millivolts to 400 volts and ground referenced inputs from 2.4 volts to 100 volts.



Relay Module

This unit has two relays that may be operated by transistors that are rated to carry at least .075A in a 12-volt circuit. Each relay has DPDT contacts for controlling external loads. The relays are plug-in type for easy replacement. The 12-volt power for the relays is provided from the AC input.

120 VAC input power 51611-400
240 VAC input power 51611-401

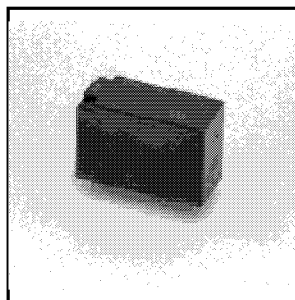


Desk Mounting Kits

These attractive desk mounting kits fit the Durant Series 5880 count controls for installation on any flat surface. The convenient two piece "snap together" design requires no tools for assembly. Four non-skid rubber feet prevent the control from sliding on the mounting surface. Standard conduit knockouts are provided on the rear of the kit for wiring to the process. The 58802-410 kit fits the 58810-400 Totalizer. The 58802-420 kit fits all other 5880 series count controls.

58802-410
58802-420

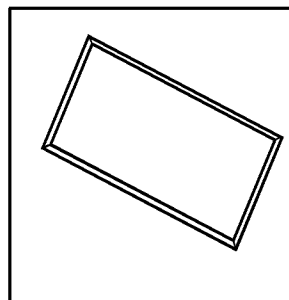
REPLACEMENT PARTS



Replacement Relay Revision 60 - up

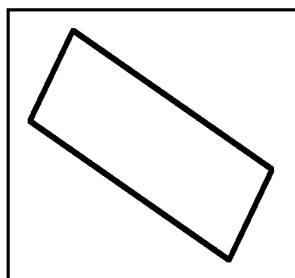
Eaton No.: 38133-202

Aromat No.:
JW1FEN-B-DC5V



Front Panel Spacer

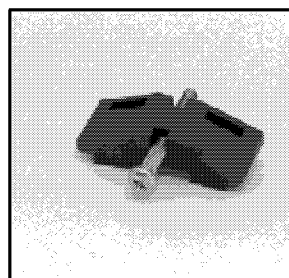
Adapter to JIC
enclosures
All Controls
38820-400
Totalizer (58810-400)
38810-400



Front Panel Gaskets

All Controls
28720-216

Totalizer (58810-400)
28720-215



Mounting Clip 48433-200

Screw
29801-187

Printed in U.S.A.

Cutler-Hammer
901 South 12th Street
Watertown, WI 53094
920-261-4070 . 800-540-9242 . FAX 920-261-9097