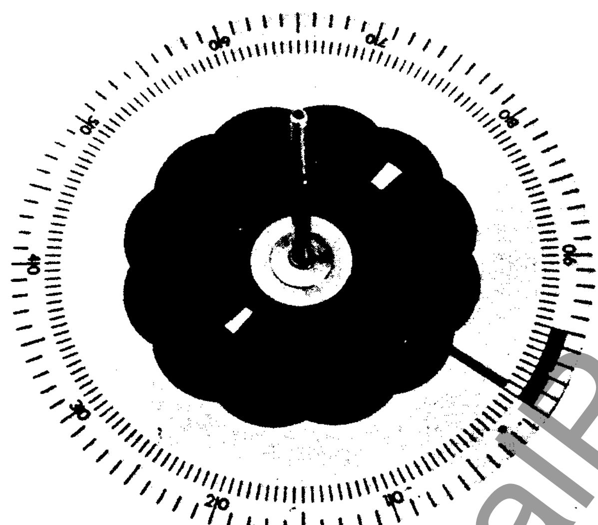
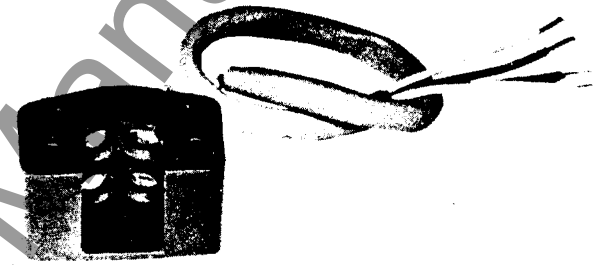
INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

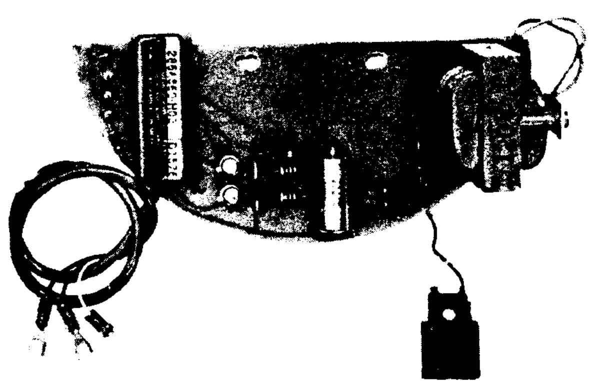
PHOTOELECTRIC PULSE INITIATORS
TYPES CDI-12B AND CDI-22B
FOR USE ON ALL D4 POLYPHASE WATTHOUR METERS



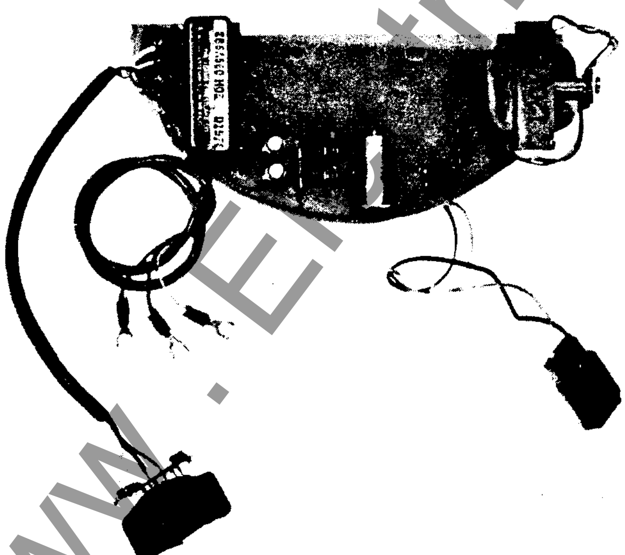
D4 Polyphase Printed Disk



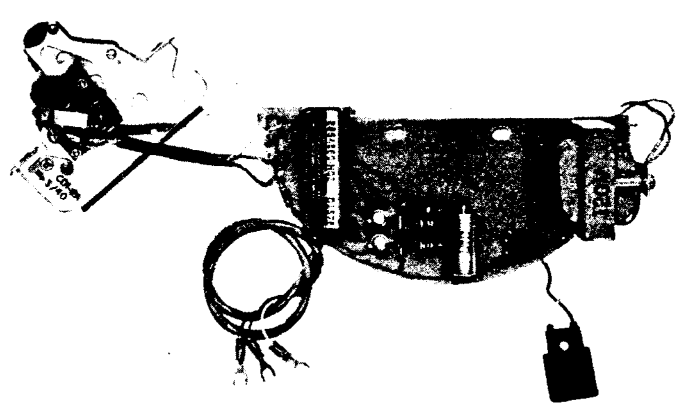
Type 22B Sensing Head Assembly



D4 Polyphase Power Supply Board Assembly



CDI-22B Power Supply Board And Sensing Head Assembly



CDI-12B Power Supply Board And Sensing Head Assembly

Supersedes IL 42-573 Dated August 1976

JANUARY 1977

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INSTALLATION • OPERATION • MAINTENANCE

CDI-12B AND CDI-22B PHOTOELECTRIC PULSE INITIATORS

INTRODUCTION

The Westinghouse CDI-12B and CDI-22B photoelectric pulse initiators provide pulses at a rate proportional to the speed of the moving element in a watthour meter. The output pulse rate of the pulse initiator is set for any given unit. These photoelectric pulse initiators were designed using all solid-state discrete electronic components to provide high pulse rates, high reliability, maximum efficiency, long life, low maintenance, complete and easy repairability, and negligible or no loading on the meter.

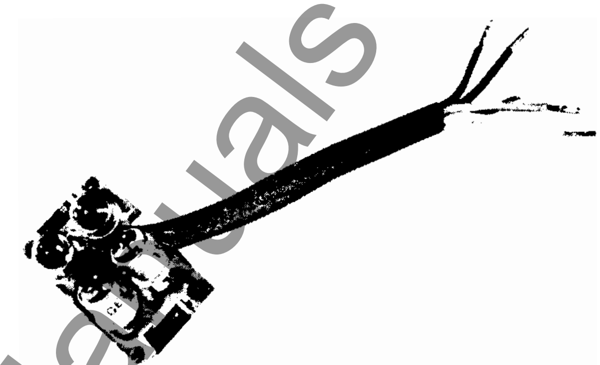


Figure 1
Sensing Head Component Assembly

GENERAL DESCRIPTION

The Types 12B and 22B photoelectric pulse initiators use the same basic type sensing head consisting of two light-emitting diodes, two phototransistors, and associated printed circuit board mounted in a molded plastic block with suitable optical apertures as shown in Figure 1. Energy from the light-emitting diodes is reflected by the meter disk (22B) or through the shutter disk (12B) onto the phototransistor of the two sensor source pairs in an alternating sequence. The output of each phototransistor is used to toggle the outputs of two switching transistors, ST 1 (see schematic, Page 18). Pulses are alternately fed into the switching transistors, which turn on a Form "C" mercury-wetted, SPDT, self-latching relay (KYZ output). The main advantage of a latching relay circuit is in the circuit's inability to be triggered unless the photosensitive circuit is exposed to the light-emitting diodes alternately. Therefore, one phototransistor cannot initiate two consecutive pulses. The pulse initiating light-emitting diodes operate in the near infrared wavelength region. This is the most efficient operating region of the system which results in a lower watt loss.

A voltage clamping circuit (Z1, R2 - see the schematic on Page 18) is used to regulate dc voltage supply of the pulse initiator. The dc voltage supply allows a faster and more efficient operation. The voltage clamping circuit clamps the circuit dc voltage which alleviates any problems due to line voltage fluxuation or voltage abnormalities

The Types 12B and 22B initiators have a mercury-wetted relay output. This provides a universal long life SPDT (Form C) contact for driving most types of pulse receivers. Both types of initiators are electrically identical and operate with the same basic circuitry.

The Type 22B operates from reflective spots on the meter disk. This completely eliminates all gearing and resultant friction and allows a relatively large number of pulses per disk revolution. This type of operation requires a meter disk with the pulse matrix printed on it. Pulse capability range is given in Table I, Page 15.

The Type 12B initiator operates by means of a slotted shutter disk assembly geared to the disk shaft of the meter (Figure 2, Page 2). The gearing allows many different values of pulse constants and many disk revolutions per pulse. The Type 12B requires a meter disk with a 13-tooth pinion on the shaft just below the disk. Pulse capabilities are given in Table I, Page 15.

The Type 12B pulse initiator offers pulse gear train ratios (Pg) from 625/9 to 3/2, plus a choice of shutter disk slots X 2 of 2 through 20 (even numbers only). This makes possible a wide choice of pulse rates from the CDI-12B geared photoelectric pulse initiators. See Table I, Page 15, and Table II, Page 16.

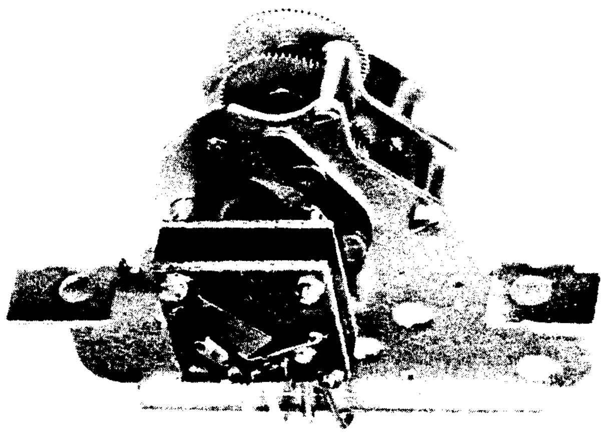


Figure 2
CDI-12B (Less Transformer And Power Supply Board) For D4 Polyphase Meters

By using the Kh of the watthour meter (watthours per disk revolution) in conjunction with the energy value desired for each pulse (Ke), the disk revolutions per pulse can be calculated. Based on this, the best combination of disk slots and pulse gearing ratio can be determined from the pulse value desired. Formulas for calculating these values are given in Application Notes under Application Calculations, Page 8, for the Types 12B and 22B initiators.

Each Type 12B initiator has a ratchet to prevent meter disk reverse rotation. Detenting is achieved by means of an escapement action ratchet on the pickoff shaft of the contact device. A separate detent is available for the Type 22B initiator. See the section on Detent Installation, Page 7.

All D4 polyphase meters, including switchboard, with any type of pulse initiator has an identification tag mounted on the front of the meter usually under one of the nameplate mounting screws identifying the type pulse initiator, voltage, Mp, and Pg, if applicable. For meters with demand registers, the tag is located on the front of some demand registers.

It is recommended that the Pg be limited to keep the initial friction loading within reasonable limits (an absolute minimum Pg of 1.5 is recommended). Engineering tests show that at a Pg of 3, the friction loading begins to increase exponentially. Pg in conjunction with meter torque are two major factors that cause friction loading increases on all gear-driven contact devices with the rate of increase proportional to the initiator loading on the meter. Figure 3, Page 3, shows the maximum allowable friction loading on meters at light load.

PRINCIPLES OF OPERATION

The general schematic for the CDI-12B and CDI-22B pulse initiators is shown on Page 18. The pulse initiators operate from dc voltage, which is generated by a 10 to 20 vac secondary winding of the power supply transformer T1, capacitor C1, and diode bridge D1. The Zener diode (Z1) regulates the dc voltage. The two phototransistors (PT1) and two light-emitting diodes (LED 1) operate from this regulated dc voltage supply.

The phototransistor conducts current when it is exposed to light. When the phototransistor is darkened, it behaves as an open circuit. When either phototransistor is exposed to light, it conducts current, and a voltage drop occurs across R5 resistor. This voltage drop is called the output of the phototransistor. Therefore, the output of the phototransistor will be near zero (o) vdc (termed a "low") when it is darkened and at approximately the regulated dc voltage (termed a "high") when it is exposed to light.

The energy source used for triggering the two phototransistors are two light-emitting diodes (LED 1) in series as shown in the schematic on Page 18. Therefore, both LEDs emit a constant output energy level since the supply voltage is dc. The series resistor (R4) is used for current limiting the LEDs.

The outputs of the two phototransistors are used to feed the bases of the switching transistors (ST1) in order to cause them to alternately conduct when energized. As each phototransistor conducts in an alternating sequence, each switching transistor alternately conducts. Each conduction is defined as one pulse. Due to physical sensor source pair isolation and the printed matrix design on the meter disk, both outputs cannot conduct simultaneously, which is essential for proper operation. The pulses generated by this conduction, in turn, alternately switch the dc supply across the two operating coils of the mercury-wetted relay (REL 1). This relay thus provides a self-latching KYZ hard contact output. A permanent magnet in the relay latches it in the new position and holds it there when the phototransistive circuit is no longer exposed to the first LED. If the photosensitive circuit should be re-exposed to the first LED before the second LED, it only serves to hold the relay in the position in which it is already latched. When the photosensitive circuit is then exposed to the second LED, the current through the relay flows in the opposite direction. This reversal of current through the relay causes the relay contacts to transfer to the opposite side. This gives a 3-wire, Form "C" output.

POWER OUTAGE

The pulse initiator circuitry may assume a random state during power outages and, therefore, the first pulse after powering up generated by the circuit may be incorrect; however, the second pulse will be in the correct sequence.

INSTALLATION OF COMPONENTS

The Types 12B and 22B pulse initiators are assembled at the factory directly to the meter; therefore, field installation of the complete assembly or components will not often be required except for repair or adding initiators to standard meters. The Type 22B sensing head is assembled just above the disk on the two round tapped studs as shown in Figure 4. The mounting of the printed circuit board is made just under the nameplate and is anchored by the nameplate mounting screws.

Figure 4
Installation of A Power Supply Board Assembly (Used for Both CDI-12B And CDI-22B) And A CDI-22B Sensing Head Assembly

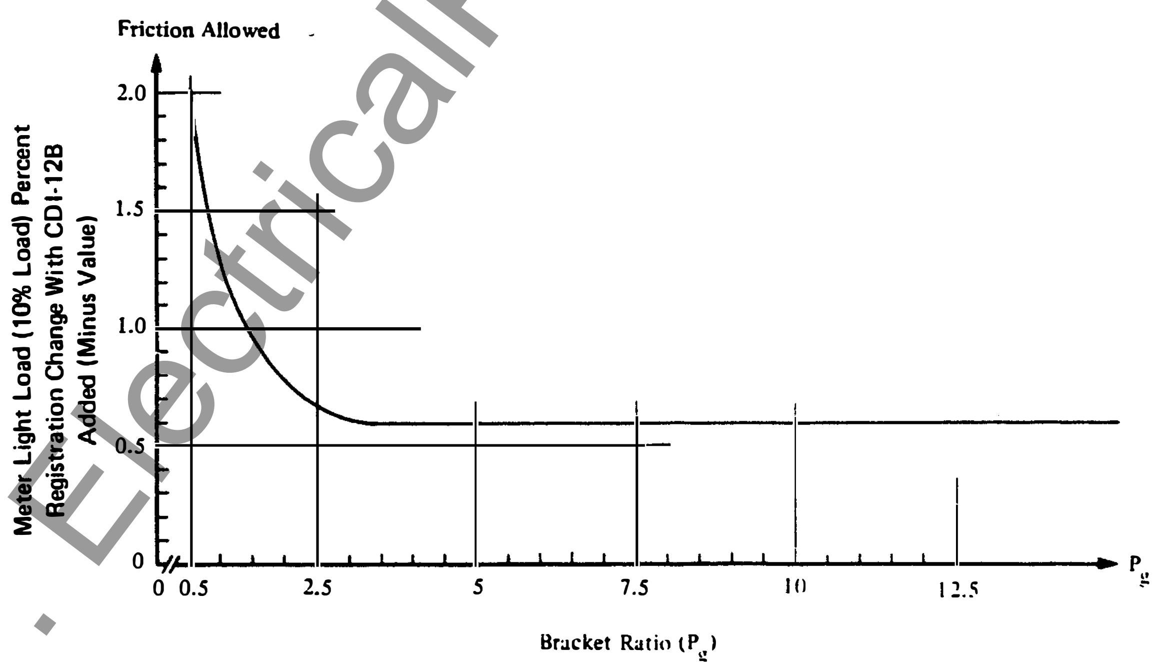


Figure 3
Bracket Ratio - Maximum Allowable Friction Loading on Meters at Light Load

FIELD REMOVAL AND INSTALLATION OF SENSING HEAD AND POWER SUPPLY

To remove the CDI-12B and CDI-22B initiators in the field from D4 polyphase meters, the register, nameplate, printed circuit board assembly, and damping magnet assembly must first be removed in order to remove the sensing head. For the Type CDI-22B initiator, the meter disk must also be checked to determine if it has the desired printed matrix. If not equipped with the desired matrix, a disk with the proper matrix must be installed. Then install the sensing head, damping magnet*, initiator printed circuit board, register, and nameplate. The meter and initiator are then ready to operate. (*IMPORTANT - The permanent magnet assembly has been calibrated for each particular meter and, therefore, is not interchangeable on other meters.)

The centerline of the Type 22B sensing head (lengthwise) should be in line with the center of the disk shaft as shown in Figure 5. The center of the two sensor pairs light transmission holes in the bottom of the sensing head should fall halfway between the inner row of reflective surfaces on the disk and the outer row of reflective surfaces. The initiator should be adjusted until the sensing head appears level to the eye with the meter disk with a gap between 0.045 inch to 0.075 inch. When the initiator has been completely installed, it should be checked for proper operation by testing KYZ hard contact output with an ohmmeter. See the KYZ color code chart below.

KYZ WIRING COLOR CODE CHART

Lead Color	Terminal Position On Meter Base With Standard Contacts
Red	K
Yellow	Y
Black	Z

The Type 12B initiator consists of an assembly of a sensing head and a bracket containing gearing and a slotted shutter disk. This assembly is shown on the cover page. The Type 12B printed circuit board assembly mounts on the D4 polyphase meter frame by the nameplate mount-

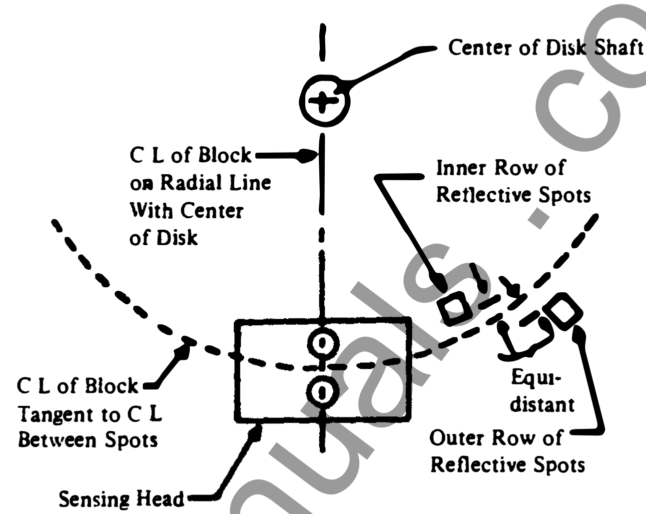


Figure 5
Proper CDI-22B Sensing Head Location

ing screws as shown in Figure 4, Page 3. The gear train meshes with a 13-tooth pinion on the disk shaft below the case which drives the gear train.

The Type 12B initiator for D4 polyphase is mounted below the disk by two shoulder screws and an adjustable third support post (C) as shown in Figure 6, Page 5. The gear train meshes with a 13-tooth pinion on the disk shaft below the disk which drives the gear train.

To mount the initiator gear train assembly:

1. Remove nameplate & printed circuit board assembly.
2. Carefully insert initiator into frame and disk area below the disk and damping magnet. Tilt initiator with pickoff gear (B) higher than main plate to get this gear behind the damping magnet housing to engage with pinion (A) on the disk.
3. After the mounting ears touch the frame, lift the plate so that the third support screw post goes into the mainplate hole, and holes in mounting ears line up with threaded mounting holes in meter frame.
4. Install initiator mounting screws (G), Style Number 1R346P01 shoulder screws, through holes in main plate ears and threaded holes in frame. Install the right side screw (in round hole) first, without tightening completely and then the left screw (in elongated hole) next to assure proper alignment of the contact device with the meter disk shaft. Then tighten both screws securely.

5. The main plate should just touch the shoulder on the third support screw post if the post has not been disturbed while the initiator was off the meter.

6. Anchor the main plate to the third support post by installing lockwasher (E) and lower hex nut (F). If support post has not been disturbed, it will be locked so as not to turn in damping magnet housing when lower nut is tightened.

7. Look through the side of the meter just above the current winding to check the mesh between the pulse initiator pickoff or engaging gear (B) and pinion (A) on the meter disk shaft. The disk shaft should be free to move forward slightly when the disk is pulled from the front of the meter and should move backward without coming out of mesh.

8. Replace sensing head cable leads (if not already connected) to the appropriate terminals or plug inside the meter.

9. Replace meter nameplate and printed circuit board assembly.

Adjusting Mesh As Required

If for some reason the mesh appeared incorrect in Step 7 above, it can be adjusted by means of the third support post as follows:

1. To get deeper mesh, loosen third support lower nut (F) and locking nut (E). Screw support post in approximately one-quarter turn.

2. To reduce depth of mesh, loosen third support nuts (E) and (F) and screw support post out approximately one-quarter turn.

3. Retighten support locking nut (E) against permanent magnet housing (H) and retighten lower hex nut (F).

4. This adjustment will move initiator main plate up or down enough to position engaging gear mesh in disk pinion (A). Mesh should be from one-half to three-quarter deep.

Another method for checking the proper depth of mesh between the pulse initiator pickoff gear (B) and the driving pinion on the meter disk (A) is as follows:

1. Mesh should be deep enough to assure proper detent action. Detent action can be checked by holding the meter in the operating position and trying to spin the disk lightly in the reverse direction with the finger (or with reverse load on the meter). Detent should not allow disk to turn more than one-tenth revolution in reverse.

2. Mesh is not too deep if pulse initiator pickoff gear (B) is free enough in the disk shaft pinion (A) to fall back

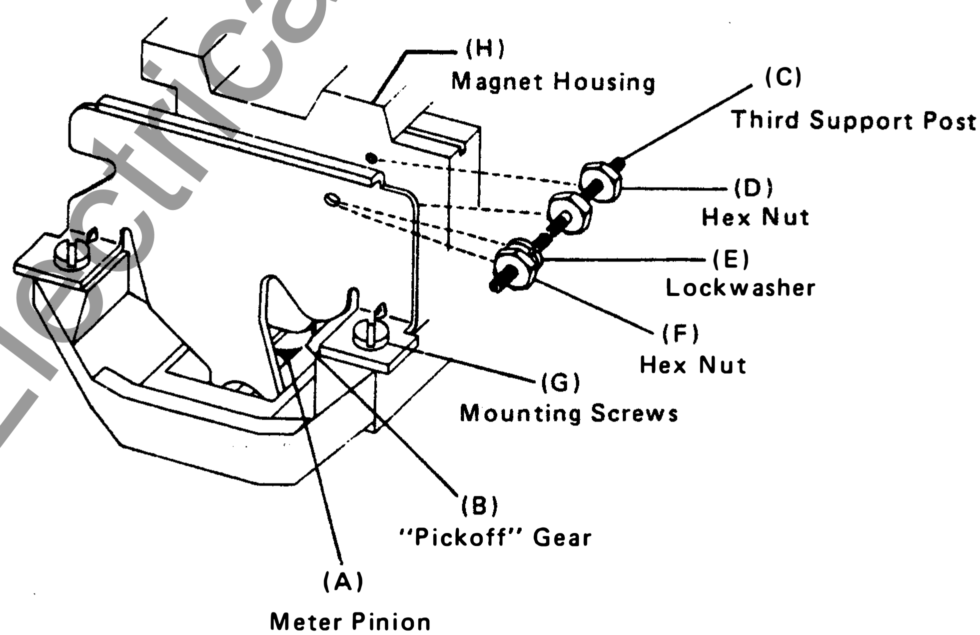


Figure 6
CDI-12B Initiator And Detent Installation For D4 Polyphase Meter

down when lifted carefully with a small probe or screwdriver with the meter in the operating position. If gear tends to stick up, mesh is too deep.

3. Pulse initiator will operate with lowest friction load on meter when mesh is just deep enough to give good detenting action. This will be between one-half and three-quarter mesh deep.

NOTE: All switchboard D4 meters have the identical initiator mounting as described above.

CDI-12B AND CDI-22B INTERNAL POWER SUPPLY

The CDI-12B and CDI-22B power supply is part of the printed circuit board assembly which is attached to the meter as previously discussed on Page 4. The CDI-12B and CDI-22B are available in 120, 240, 277, and 480 VAC styles. Line voltage is supplied to the input of the power supply by the two color-coded female plugs' leads (Yellow-Black, 120 VAC; White-Black, 240 VAC; Red-Yellow, 277 VAC; and, Brown-Black, 480 VAC).

The leads attach to a double male plug which is connected to the primary of the power supply transformer. The plug is mounted on the left side of the meter by the potential coil mounting screw nearest the base. Figure 7 shows the plug assembly mounted on a D4 polyphase meter.

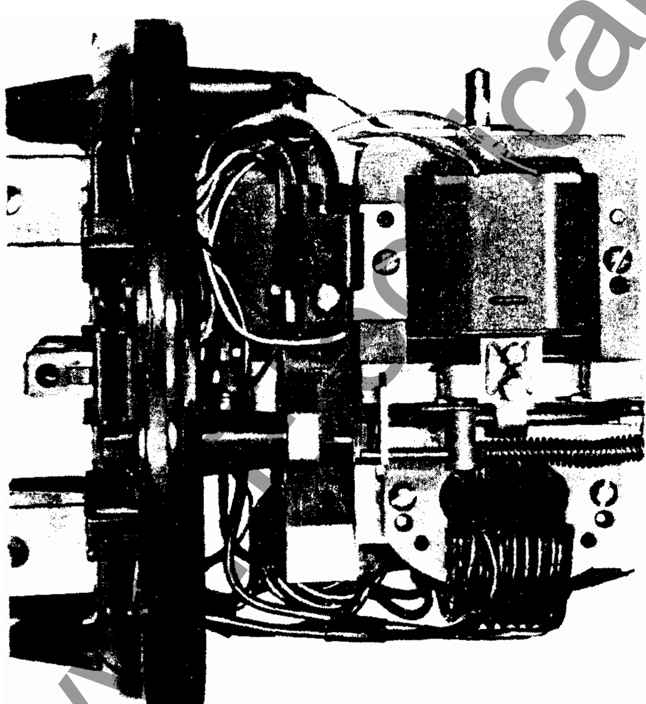


Figure 7
Plug Assembly Mounted on D4 Polyphase Meter

The color-coded leads of the sensing head are soldered to the pin terminals located on the printed circuit board in order to provide a disconnect between the sensing head and the printed circuit board. If a new replacement sensing head becomes necessary, simply resolder the leads to the pins in the printed circuit board. Figure 8 shows the proper color-coded lead pin connections.

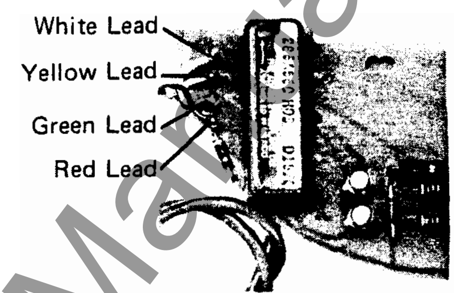


Figure 8
D4 Polyphase CDI-12B, 22B Sensing Head
Lead Terminal Pins (Color Coded)

KYZ OUTPUT TERMINALS

The K, Y, and Z output from the relay on S-base and A-base meters are connected to the terminals located in the base in accordance with MSJ-10 standards and appropriate Westinghouse instruction leaflets. Standard use of the KYZ plug disconnect on the meter base, the leads through a hole and rubber grommet in the base, and use of spare terminals are all methods used for the various type meters to provide KYZ output terminals. For additional information, see Westinghouse I. L. 42-571 covering photoelectric pulse initiators and the various instruction leaflets covering the individual meters. Also, see the KYZ wiring color code chart on Page 4 herein.

IMPORTANT: After installation, lightly tap the mercury-wetted relay to cause the mercury to drop into position.

NOTE: Types 12B and 22B external power supplies are not planned in this design. If the user must use this type power supply, the previous Types CD-12 and CD-22 external power supplies are available from Westinghouse. See I. L. 42-571 for complete information.

FIELD INSTALLATION OF COMPLETE INITIATORS

Whenever possible, it is recommended that meters equipped with pulse initiators be ordered complete from the factory. Meters that will have initiators added at a later date should be ordered with the KYZ terminals in the base, KYZ cable installed (same as for mechanical initiators) or D4 self-contained polyphase meters, and with printed spots on the disk for the Type 22B.

To adapt a standard D4 polyphase meter or switchboard watthour meter to a pulse initiator, the following steps should be taken:

Type 22B

1. Check to see if the meter has a printed matrix on top of the disk. If not, a new disk with the desired printed matrix (Table I, Page 15) must be installed.

2. Wiring diagrams in the instruction leaflet of the appropriate meter give the KYZ terminal location in the base for external connection. Check to see if the meter has KYZ terminals in the base or provisions for KYZ cable. If the base does not have these provisions, then a new base may have to be ordered. Install external KYZ cable, if required, in the appropriate locations in the base of the meter.

3. Install the sensing head and power supply for the various types of meters as explained on Page 4.

NOTE: It may be desirable to install a detent when the Type 22B is installed or on meters already containing the Type 22B. When ordering the detent, specify the assembly Style Number 246C779G01. This will include the hardware required for proper installation and an instruction sheet. Although an instruction sheet will be provided with the detent, complete instructions for installing and adjusting the detent are given herein.

Type 12B

1. Check to see if the meter has a 13-tooth pinion cut on the shaft just below the disk. If not, a new disk must be installed.

2. Wiring diagrams give the KYZ terminal location in the base for external connection. Check to see if the meter has KYZ terminals in the base or provisions for KYZ cable. If not, a new base may have to be ordered. Install external KYZ cable, if required, in the appropriate location in the base of the meter.

3. Install the Type 12B and power supply for the various types of meters as explained on Page 4.

REMOVING THE TYPE 12B INITIATOR

If necessary to remove the Type 12B initiator from the D4 polyphase meter, see Figure 6, Page 5, and use the following procedure:

1. Remove meter nameplate and printed circuit board.

2. Do not remove the register or the permanent magnet (damping magnet).

3. Remove lower nut (F) and lockwasher (E) from third support post (C). Do not loosen nut (D) or the third support from the damping magnet housing.

4. Remove the two shoulder screws (G) from main plate mounting ears which attach the gear train assembly to the meter frame.

5. Carefully remove initiator gear assembly forward and down to clear damping magnet. Carefully lift out.

NOTE: Do not remove or disturb third support post (C) or locking nut (D) while servicing the initiator. This will facilitate reinstallation without readjustment.

6. Disconnect KYZ cable leads from appropriate terminals or plug inside meter. Note color code and terminals for proper reinstallation.

INSTALLING DETENT

See Figure 6, Page 5, and use the following procedure to install the detent:

1. Insert third support post (C) into permanent magnet (damping magnet) as far as it will go. Remove lockwasher (E) and hex nut (F) from post.

2. Carefully insert detent into frame and disk area between disk and damping magnet. Tilt detent with pickoff gear higher than main plate to get this gear behind damping magnet housing to engage with pinion on disk.

3. After mounting ears touch frame (H), lift plate so that third support screw post (C) goes into hole in the main plate and holes in mounting ears line up with threaded mounting holes in meter frame.

4. Install detent mounting screws (G), Style Number 1R346P01, shoulder screws, through holes in main plate ears and threaded holes in frame (H). Install right screw (round hole) first, without tightening completely, and then left screw (elongated hole) next to assure proper alignment of detent with meter disk shaft. Tighten both screws securely.

5. Adjust third support post (C) until hex shoulder of post touches main plate. This should give the proper mesh. Tighten hex nut (D).

6. Anchor main plate to third support post by installing lockwasher (E) and lower hex nut (F). If support post has not been disturbed, it will be locked so as not to turn in damping magnet housing when lower nut (F) is tightened.

7. Look through side of meter just above current winding to check mesh between detent "pickoff" or engaging gear (B) and pinion (A) on meter disk shaft. The disk shaft pinion should be free to move forward slightly when disk is pulled from front of meter and should move backward when pushed without coming out of mesh.

8. To get deeper mesh, loosen third support lower nut (D) and locking nut (F), and screw support post (C) in approximately one-quarter turn.

9. To reduce depth of mesh, loosen third support nuts (D) and (F) and screw support post (C) out approximately one-quarter turn.

10. Retighten support locking nut (D) against permanent magnet housing and retighten lower hex nut (F).

11. This adjustment will move detent main plate up or down enough to position engaging gear mesh in disk pinion (A). Mesh should be from one-half to three-quarter deep.

Another method for checking proper depth of mesh between detent pickoff gear (B) and the driving pinion on meter disk (A) is as follows:

1. Mesh should be deep enough to assure proper detent action. Detent action can be checked by holding the meter in the operating position and trying to spin the disk lightly in the reverse direction with the finger (or with reverse load on the meter). Detent should not allow disk to turn more than approximately one-sixth revolution in reverse.

2. Mesh is sufficiently free if detent "pickoff" gear (B) is free enough in disk shaft pinion (A) to fall back down when carefully lifted with a small probe or screwdriver with the meter in the operating position. If gear tends to stick up, mesh is too deep.

3. Detent will operate with lowest friction load on meter when mesh is just deep enough to give good detenting action. This will be between one-half and three-quarter mesh deep.

APPLICATION CALCULATIONS

Type 12B Pulse Initiator

The geared photoelectric pulse initiator when mounted on a meter (Figure 6, Page 5) sends pulses which are proportional to a desired number of kilowatt-hours. A variety of gear ratios are available which will rotate the slotted shutter disk shaft at the desired speed.

The gear ratio from the meter disk shaft to the slotted shutter shaft is designated as Pg (term formerly known as bracket ratio and designated as Br). For example, the shutter disk shaft of an initiator with a Pg of 20 rotates one revolution for each 20 revolutions of the meter disk shaft.

By definition:

Pg = Number of meter disk shaft revolutions for 1 revolution of the shutter disk shaft.

Pg = Ps X Pr, Electrical Metermans Handbook, 7th Ed., Ch. 10.

Mp = Number of meter disk shaft revolutions to cause 1 pulse (contact closure).

$$Mp = \frac{Ke}{Kh}$$

Where: Ke = Energy value desired per pulse.

Kh = Energy value of each disk revolution. (Both values must be in the same terms.)

By definition: S = Number of slots in the shutter disk. The CDI-12B pulse initiators are 3-wire type initiators and are designed such that the total number of output pulses per shutter disk shaft revolution equals 2 X S.

Shutter disk slots (S) from 1 to 10 and many pulse gearing ratios (Pg) are available, making a variety of combinations for a wide selection of standard Mp values. Many combinations are on Table II, Page 16. Many others can be calculated from the formula:

Pg = Mp X 2(S)

The values of Mp are marked on the main plate of the initiator while the Pg is stamped on the subplate. From these values and the Kh (marked on the meter nameplate), the value of each pulse can be verified.

For example:

A pulse value equal to 10 kilowatt-hours is desired from a D4S-3, 3-phase, 4-wire Wye, 3-element meter, 120 volt, 2.5 amperes, secondary Kh - 1.8 (watthours per revolution). The meter is used with 14,400/120 volt potential transformers (120/1) and 200/5 ampere current transformers (40/1). The CDI-12B chosen has a shutter disk with three slots (S) and the pulse gearing (Pg) equal to 125/18 or 6-17/18.

Primary Kh = Secondary Kh X PT ratio X CT ratio = 1.8 X 120 X 40 = 8,640 watthours or 8.64 kwh.

Ke = 8,640 X Mp

$$Mp = \frac{Pg}{2xS} = \frac{125/18}{2x3} = \frac{125}{18} \times \frac{1}{6} = \frac{125}{108}$$

$$Ke = 8,640 \times \frac{125}{108} =$$ 10,000 watthours or 10 kwh per pulse, which is the correct desired value.

Gear ratios (Pg) and shutter disk slots (S) X 2 are available to produce combinations given the Mp values shown in Table II, Page 16. Other special combinations may be possible; however, Pg values above 3/1 give the best operation. Because of the mechanical load on the meter, Pg values below 3/2 (1.5) are not recommended.

CALCULATION OF MAXIMUM PULSE RATES FOR TYPE 22B PULSE INITIATOR

To determine the maximum permissible pulse rate, the user must take into consideration the following variables:

(1) Maximum meter disk speed (determined by the maximum load expected and the basic meter design speed).

$$\text{Maximum Disk Revolutions Per Hour} = \frac{\text{Rated Voltage X Maximum Load Current Expected}}{\text{Nameplate Kh}}$$

Nameplate Kh = Watthours per revolution.

(2) CDI-22B pulse initiator pulse output (for maximum meter disk speed as shown in (1) above).

$$\text{Desired Pulses Per Hour} = \frac{\text{Maximum Disk Revolutions Per Hour}}{\text{Mp}}$$

$$\text{Mp (Disk Revolutions Per Pulse)} = \frac{1}{\text{No. Reflective Surfaces On Disk}}$$ (Always in pairs or even numbers, 2 through 16.)

(See Table 1, Page 15, for various values of Mp.)

Once the above calculations are made, the final value of the Desired Pulses Per Hour must stay within the user's specification limits for pulses per hour (see Specifications and Descriptions, Page 12). When these values are exceeded, the user must then resort to: (1) Go to a higher user specification speed, or (2) Use a meter disk with less reflective surfaces. The limiting factor for maximum pulses per hour will generally be the user's application limit since the CDI-22B initiator, itself, can handle many times maximum meter speed rates (30 pulses per second maximum).

EXAMPLE:

Given STD. D4S-2, Class 200, 120-volt meter. Kh = 14.4 Maximum Load Current Expected = 180 Amps.

(1) $$\text{Max. Disk Rev. Per Hour} = \frac{240 \text{ X } 180}{14.4} = 3000 \text{ Rev. Per Hour.}$$

Assume: User desires a maximum of 6000 pulses per hour and wishes to know what Mp is required.

(2) $$6000 \text{ Pulses Per Hour} = \frac{3000 \text{ Rev. Per Hour}}{\text{Mp}} \qquad \text{Mp} = \frac{3000}{6000} = \frac{1}{2} \text{ Rev. Per Pulse}$$

Since the pulse initiators can only operate with pairs of reflective surfaces (even numbers), the proper meter disk to be used is a "2-spot" disk.

CONTACT PROTECTION

The output relay used with the Types 12B and 22B pulse initiators has the potential for an extremely large number of operations; however, this potential can not be approached unless the contacts have the proper arc suppression. The type of protection required depends on the type of load being switched.

(A) Resistive Loads - AC or DC (computer input, WT input, etc.)

For this type of load, a series resistor-capacitor network is required across each contact as shown in Figure 9a. Values R and C are given by the following formulas:

$$C = \frac{I^2}{10} \qquad R = \frac{E}{10\,(I)^X}$$

Where:

C = microfarads
R = ohms
I = current in amperes immediately prior to contact openings
E = source potential in volts immediately prior to contact closure
$X = 1 + \frac{50}{E}$

Peak values of I and E are used for AC. If C calculates to be less than 0.001 microfarad, use 0.001 microfarad for C. If R calculates to be less than 1 ohm, use 1 ohm for R. R should have a tolerance of plus, minus 5 percent.

The following sample calculations illustrate the contact protection required for a Westinghouse Type WT-2 totalizing relay. The totalizer input impedance is 11,000 ohms resistive and the voltage is 120 VAC.

Since peak values must be used:

$E = 120 \times 1.41 = 169$ volts

$$I = \frac{E}{R} = \frac{169}{11{,}000} = 15.4 \text{ milliamperes}$$

Calculating the C required:

$$C = \frac{I^2}{10} = \frac{(0.0154)^2}{10} = 23.7 \text{ micromicrofarads}$$

Since this is less than the 0.001 microfarad minimum capacitance, the value of C for this application should be 0.001 microfarad.

Calculating the value of X:

$$X = 1 + \frac{50}{E} = 1 + \frac{50}{169} = 1.269$$

Calculating the value of R:

$$R = \frac{E}{10(I)^X} = \frac{169}{10(0.0154)^{1.296}} = 2{,}840 \text{ ohms}$$

The capacitor voltage rating should be no less than twice the calculated peak voltage. The resistor wattage rating should be no less than twice the calculated I^2R value.

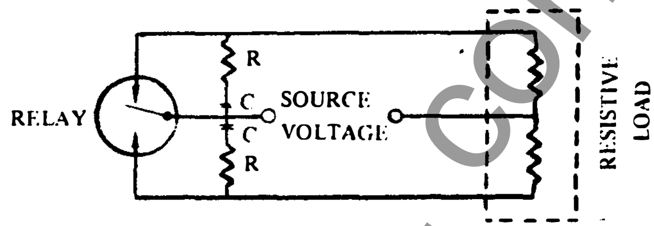


Figure 9a
Contact Protection For AC Or DC Resistive Loads

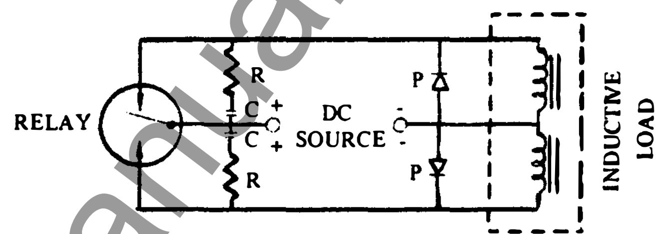


Figure 9b
Contact Protection For DC Inductive Loads

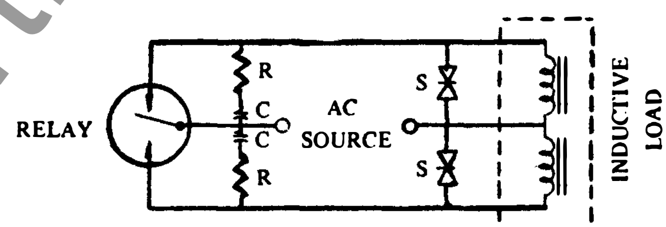


Figure 9c
Contact Protection For AC Inductive Loads

(B) Inductive loads - DC (relay circuits, printing recorders, etc)

For this type of load, a resistor-capacitor network as described above is required, plus a diode across the load coil as shown in Figure 9b, Page 11. For loads up to 200 volts, any silicone diode rated at 400 volts and 1 ampere may be used. An example of such a diode is the Westinghouse 1N1222. In applying this type of protection, it should be noted that the diode slightly increases the delay time of the load current. However, at rates normally used in pulse metering, this delay is negligible.

IMPORTANT: In a system with this type of protection, the diodes and source voltage must always be connected as shown. Reversing polarity of either one would cause a direct short and destroy the relay contacts.

(C) Inductive Loads - AC (relay circuits, printing recorders, etc.)

For this type of load, a resistor-capacitor network as described above is required, plus a surge suppressor across the load coil as shown in Figure 9c, Page 11. For 120 VAC loads of 1/2 ampere or less, a suitable suppressor is an International Rectifier Type S6Z6P contact protector. An alternate to this would be to use two 180-volt, 1-watt Zener diodes back-to-back across each load coil. A suitable diode would be a IN3050.

For loads not included in the above discussion, the nearest Westinghouse sales representative should be consulted.

Lead Lengths

The maximum lead length between the CDI-12B and CDI-22B and the receiver will be a function of the receiver design and supply voltage used.

Output Pulse

The output relay of the Types 12B and 22B has a mercury-wetted contact of the SPDT Form C (break-before-make type). This produces an extremely fast, completely bounce-free contact action which is ideal for triggering electronic circuits such as computers and counters.

Pulse Rates

The pulse rates of the Type 22B are fixed by the matrix printed on the top of the disk. Available pulses per disk revolution values are given in Table I, Page 15.

The pulse rates of the Type 12B can be varied greatly according to the application. Available pulses per disk revolution are given in Table I. See Table II, Page 16, for the complete chart.

Reverse Rotation

The only detent available for the Type 22B pulse initiator is the standard detent on the meter disk. Approximately 45 degrees of reverse rotation is required for this detent to take effect. Therefore, six pulses per disk revolution is the maximum Pm which can be positively detented with the Type 22B (Table I, Page 15).

The Type 12B pulse initiator has a built-in detent. All Pm values are positively detented.

SPECIFICATIONS

Supply Voltage:

120 VAC ± 20% @ 60 Hz (Yellow-Black)*
240 VAC ± 20% @ 60 Hz (White-Black)*
277 VAC ± 20% @ 60 Hz (Red-Yellow)*
480 VAC ± 20% @ 60 Hz (Brown-Black)*

(*) Indicates color of leads on power supply plug on the transformer.

Operating voltage range is from 80 % to 120 % of the rated supply voltage.

Supply Burden:

1.4 VA at rated voltage

Watts Loss:

0.84 watt at rated voltage

Operating Temperature Range Ambient:

-30 degrees to +185 degrees F

Storage Temperature Limits - Sensing Head And Power Supplies:

-35 degrees F to +212 degrees F

Power Outage:

Will not send out extra pulses on power outage (assuming disk does not move). See Table I, Page 15, for positive detenting.

Friction Loading on Meter:

Type 22B - None
Type 12B - See Figure 3, Page 3

Output Contact Ratings:

2 amperes maximum
500 volts maximum
100 VA maximum with contact protection

Contact Life:

Up to one billion operations depending on load and suppression used.

Pulse Rate:

30 per second maximum (normally limited by meter disk speed). This can only be achieved by the 16-spot disk running at maximum speed.

MAINTENANCE

The Types 12B and 22B pulse initiators were designed using all solid-state discrete electronic components to provide high reliability, maximum efficiency, and low maintenance. The light-emitting diodes (LEDs) when used at a derated current level, as in Types 12B and 22B, have a long life capability (typically over 10 years) that is far beyond that of incandescent sources. The life of an LED is inversely related to the LED current input. For this reason, an LED current rated at 100 MA for continuous use was selected, and the operating current under maximum "worse case" conditions was reduced to 15 to 25 MA to further increase the life.

To regulate LED current and protect the LEDs from line transients, a current-limiting resistor (R4) was placed in series with LEDs which reduces the possibility of high current surge damage. The derated operating current and the current surge protection should allow the light-emitting diodes to operate for a long period of time without an adverse drop in energy output to the point of inoperatability.

Field testing of the Types 12B and 22B to prevent LED failure or adverse drop in energy output is not recommended. The electrical characteristics (i.e., forward voltage drop across the LED) of the LED do not usually change if there is a drop in energy output. Therefore, field testing would most probably indicate a "good" LED. However, field testing to determine if the system is operating properly can be done. This is simple to test and requires only an ohmmeter to check the hard contact KYZ output of the Form C mercury-wetted relay to assure that the proper pulse output is continuing over the life test period.

GENERAL TESTING PROCEDURES

The circuit board and the electronic components of the initiator are not conformal coated, therefore, individual components may easily be removed and replaced if necessary. Should the system not be operating properly, which would only be determined by either no pulse on the tape or improper voltages and currents at the recorder test jacks, see the Troubleshooting Check List which follows:

TROUBLESHOOTING CHECK LIST

1. Check for proper Mp, Pg, correct disk matrix, etc.
2. Check all plugs, connections, and circuit board connector pads.
3. Check pulse initiator mounting position as shown in Figure 4, Page 3, and Figure 6, Page 4.
4. Check sensing head position (0.045 to 0.075 gap between sensing head and meter disk) and reflective surfaces for dirt or damaged matrix.
5. Check supply voltage from transformer secondary (10 to 12 volt ac) by measuring the voltage across the Green and Yellow transformer leads.
6. Check across resistors R5 and also the individual relay REL1 coils (see schematic, Page 18) to insure that alternate DC voltage pulses are present. Minimum coil voltage to properly operate the relay (KYZ contacts) is approximately 3 volts DC.
7. Check all wiring for continuity.
8. Tap mercury-wetted KYZ relay to disperse mercury from contacts, if necessary.

Consult your nearest Westinghouse representative as to the next necessary step to solve the problem if all of the above items have been tried to no avail.

If testing indicates a good pulse initiator, the K, Y, and Z output of the relay should be checked for proper operation. Place the ohmmeter across the output leads of the power supply relay and measure the resistance change as the photosensitive circuit is alternately exposed to the LEDs. If switching between the KY and KZ leads does not occur, the relay or other initiator components or circuitry is defective.

WITHSTAND VOLTAGE

The maximum voltage that may be applied from either primary lead to the meter frame is 3,000 volts RMS. The maximum voltage that may be applied from the K, Y, or Z terminals to the meter frame is 1,000 volts RMS.

REPLACEMENT PARTS

When ordering replacement parts, fully identify by giving the symbol, catalog number, and complete description of the part. See RPD 42-573.

PARTS DESCRIPTION

Symbol	Description
T1	Transformer
REL 1	Relay AWCM-16552-1
D1	Diode Bridge MDA920A-2
R4	LED Limiting Resistor 300 Ohm, 1/4 Watt
C1	Capacitor - 100 mf 20 vdc
R1	Resistor - 16 Ohm 1/4 Watt
Z1	Zener Diode 1N4737A
	Light-Emitting Diode
LED 1	CDI-22B:LED 55B
LED 1	CDI-12B: TIL-24
	Phototransistor
PT 1	CDI-22B: TIL-81
PT 1	CDI-12B: 1N5724
	Resistor
R2	51 Ohm, 1/2 Watt
R5	68 K-Ohm, 1/4 Watt
R3	2 M-Ohm, 1/4 Watt
	Switching Transistor
ST 1	2N2222A

Table I

APPLICATION CHART

	TYPE 22B ATTACHMENT			TYPE 12B ATTACHMENT	
Meter Types	Mounting Position (Sensing Head)	Range: Pulses Per Disk Revolution (Pm) Even Numbers Only		Mounting Position (Pick-Off Gear)	Range: Pulses Per Disk Revolution
All D4 Single Phase	Below Disk	2 to 6 (See Table II)	2 to 16 (See Table II)	Below Disk	1/34.7 to 13.33
All D4A, D4S, And D4B (Switchboard)	Above Disk	Positively Detented. For Applications On Reactive Meters, Q-Hour Meters, And On Meters Used On Interchange Of Power.	For Applications On Meters Where A Forward Disk Rotation Is Always Present	(See Fig. 2 Page 2)	(See Table II) For Complete Tabulation Of Available Ratios

$$Mp = \frac{1}{Pm}$$

NOTE: For Type 22B, Mp (disk revolutions per pulse) values available are: 1/2, 1/4, 1/6, 1/8, 1/10, 1/12, 1/14, and 1/16. Denominator values correspond to total number of meter disk reflective surfaces.

TABLE II
DETAILED APPLICATION CHART
TYPE CDI-12B PULSE INITIATOR

BRACKET RATIOS AND PULSE RATES (M_p) M_p = Disk Revolutions Per Pulse

Decimal	Fract. Pg	Number of Shutter Disk Slots (S) X 2									
		2	4	6	8	10	12	14	16	18	20
1.5	3/2	3/4	3/8	1/4	3/16*	3/20	1/8	3/28*	3/32*	1/12*	3/40*
1.56	25/16	25/32	25/64	25/96	25/128	5/32	25/192	25/224*	25/256*	25/288*	5/64*
1.59	100/63	50/63	25/63	50/189*	25/126	10/63	25/189*	50/441	25/252*	50/567*	5/63*
1.66	5/3	5/6	5/12	5/18	5/24	1/6	5/36	5/42*	5/48*	5/54*	1/12*
1.74	125/72	125/144	125/288	125/432	125/576	25/144	125/864	125/1008*	125/1152*	125/1296*	25/288*
1.98	125/63	125/126	125/252	125/378	125/504	25/126	125/756	125/882*	125/1008	125/1134*	25/252*
2.00	2/1	1/1	1/2	1/3	1/4	1/5*	1/6*	1/7*	1/8*	1/9*	1/10*
2.08	25/12	25/24	25/48	25/72	25/96	5/24	25/144	25/168	25/192*	25/216*	5/48*
2.22	20/9	10/9	5/9	10/27*	5/18	2/9*	5/27*	10/63*	5/36*	10/81*	1/9*
2.31	125/54	125/108	125/216	125/324	125/432	25/108	125/648*	125/756*	125/864*	125/972*	25/216*
2.38	50/21	25/21	25/42	25/63	25/84	5/21	25/126	25/147*	25/168*	25/189*	5/42*
2.50	5/2	5/4	5/8	5/12	5/16	1/4	5/24	5/28*	5/32*	5/36*	1/8*
2.78	25/9	25/18	25/36	25/54	25/81*	5/18	25/108*	25/126*	25/144*	25/162*	5/36*
3.00	3/1	3/2	3/4	1/2	3/8	3/10*	1/4	3/14*	3/16*	1/6*	3/20*
3.12	25/8	25/16	25/32	25/48	25/64	5/16*	25/96	25/112*	25/128*	25/144*	5/32*
3.33	10/3	5/3	5/6	5/9	5/12	1/3	5/18*	5/21*	5/24*	5/27*	1/6*
3.47	125/36	125/72	125/144	125/216	125/288	25/72	125/432	125/504*	125/576*	125/648*	25/144
4.00	4/1	2/1	1/1	2/3	1/2	2/5*	1/3*	2/7*	1/4*	2/9*	1/5*
4.16	25/6	25/12	25/24	25/36	25/48	5/12	25/72	25/84	25/96*	25/108*	5/24*
4.63	125/27	125/54	125/108	125/162	125/216	25/54	125/324*	125/378*	125/432*	125/486*	25/108*
4.69	75/16	75/32*	75/64*	75/96*	75/128*	15/32*	75/192*	75/224*	75/256*	25/96*	15/64*
4.76	100/21	50/21*	25/21	50/63	25/42*	10/21	25/63	50/147*	25/84*	50/189*	5/21*
5.4	125/24	125/48	125/96	125/144	125/192	25/48	125/288	125/336*	125/384*	125/432*	25/96*
5.56	50/9	25/9	25/18	25/27	25/36	5/9	25/54*	25/63*	25/72*	25/81*	5/18*
6.00	6/1	3/1	3/2*	1/1	3/4*	3/5*	1/2	3/7*	3/8*	1/3*	3/10*
6.25	25/4	25/8	25/16	25/24	25/32*	5/8	25/48	25/56*	25/64*	25/72*	5/16*
6.66	20/3	10/3	5/3	10/9	5/6	2/3	5/9*	10/21*	5/12*	10/27*	1/3*
6.94	125/18	125/36	125/72	125/108	125/144	25/36	125/216	125/252*	125/288*	125/324*	25/72*

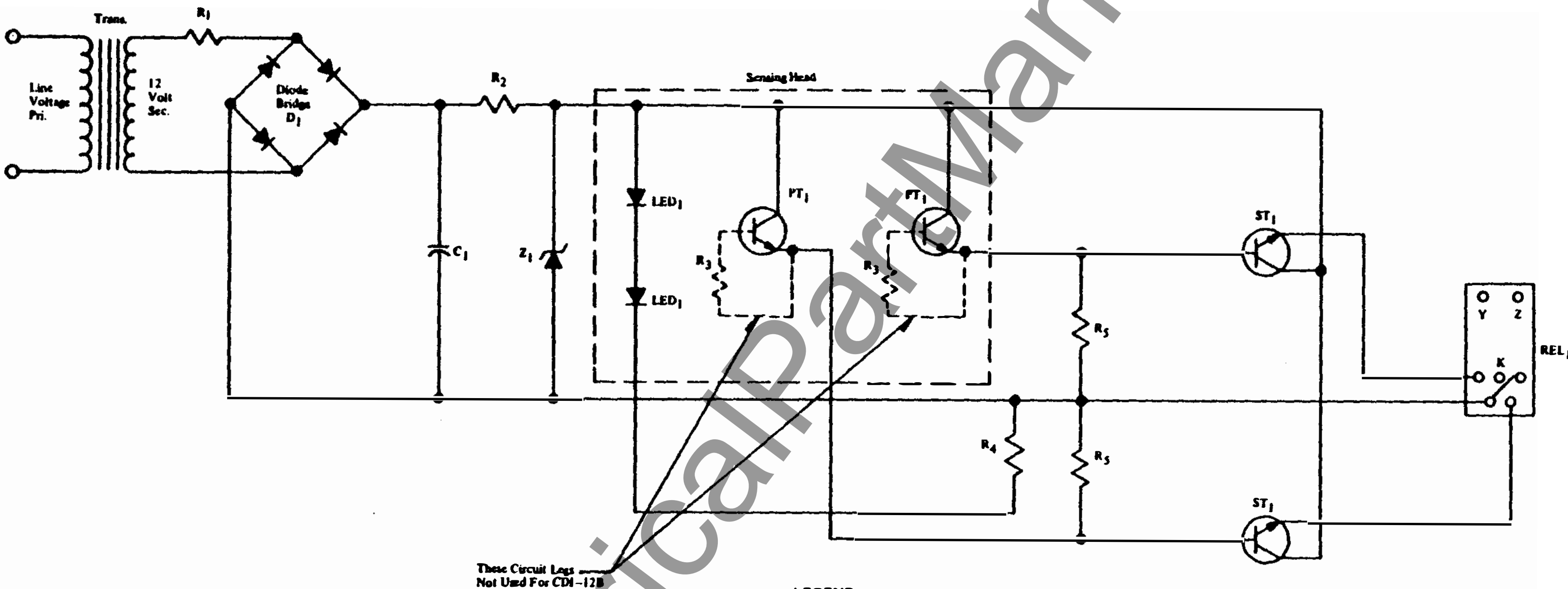
(*) Preferred Values

TABLE II (Continued)

Decimal	Fract. Pg	Number of Shutter Disk Slots (S) X 2									
		2	4	6	8	10	12	14	16	18	20
8.00	8/1	4/1	2/1	4/3	1/1	4/5*	2/3*	4/7*	1/2*	4/9*	2/5*
8.33	25/3	25/6	25/12	25/18	25/24	5/6	25/36	25/42*	25/48*	25/54*	5/12*
9.26	250/27	125/27*	125/54	125/81*	125/108	25/27	125/162*	125/189*	125/216*	125/243*	25/54*
9.65	3125/324	3125/648	3125/1296	3125/1944	3125/2992	625/648*	3125/3888	3125/4536	3125/5184	3125/5832	625/1296
10.00	10/1	5/1	5/2	5/3*	5/4*	1/1	5/6*	5/7*	5/8*	5/9*	1/2*
10.42	125/12	125/24	125/48*	125/72	125/96*	25/24*	125/144	125/168	125/192*	125/216*	25/48*
11.11	100/9	50/9	25/9	50/27	25/18	10/9*	25/27*	50/63*	25/36*	50/81*	5/9*
11.90	250/21	125/21	125/42	125/63*	125/84*	25/21*	125/126	125/147*	125/168*	125/189*	25/42*
13.33	40/3	20/3*	10/3*	20/9	5/3	4/3*	10/9	20/21*	5/6	10/27*	2/3*
13.89	125/9	125/18*	125/36	125/54*	125/72*	25/18	125/108*	125/126*	125/144*	125/162*	25/36*
16.00	16/1	8/1*	4/1*	8/3*	2/1*	8/5*	4/3*	8/7*	1/1*	8/9*	4/5*
16.53	3125/189	3125/378*	3125/756*	3125/1134*	3125/1512*	625/378*	3125/2268	3125/2646*	3125/3024*	3125/3402	625/756
19.29	3125/162	3125/324	3125/648*	3125/972*	3125/1296*	625/324*	3125/1944*	3125/2268*	3125/2592*	3125/2916	625/648
22.22	200/9	100/9*	50/9*	100/27*	25/9*	20/9*	50/27*	100/63*	25/18*	100/81*	10/9*
25.00	25/1	25/2*	25/4*	25/6*	25/8*	5/2*	25/12*	25/14*	25/16*	25/18*	5/4*
30.00	30/1	15/1*	15/2*	5/1*	15/4*	3/1*	15/6*	15/7*	15/8*	5/3*	3/2*
30.82	2500/81	1250/81*	625/81*	1250/243*	625/162*	250/81	625/243*	1250/527	625/324	1250/729	125/81*
34.72	625/18	625/36*	625/72	625/108*	625/144	125/36*	625/216*	625/252*	625/288*	625/324*	125/72*
35.71	250/7	125/7*	125/14*	125/21*	125/28*	25/7*	125/42*	125/49*	125/56*	125/63*	25/14*
39.68	2500/63	1250/63*	625/63*	1250/189*	625/126	250/63	625/189	1250/441*	625/252	1250/567	125/63*
46.30	1250/27	625/27*	625/54	625/81	625/108	125/27	625/162	625/189*	625/216	625/243*	125/54*
52.08	625/12	625/24*	625/48*	625/72	625/96*	125/24*	625/144*	625/168	625/192*	625/216*	125/48*
55.56	500/9	250/9*	125/9*	250/27*	125/18	50/9	125/27*	250/63*	125/36	250/81*	25/9*
57.87	3125/54	3125/108*	3125/216*	3125/324*	3125/432*	625/108	3125/648	3125/756	3125/864*	3125/972	625/216*
69.44	625/9	625/18*	625/36	625/54*	625/72	125/18*	625/108	625/126*	625/144	625/162*	125/36*

(*) Preferred Values

CDI-12B AND 22B
ELECTRONIC PULSE INITIATOR SCHEMATIC



LEGEND

R1 - Resistor, 16 Ohms, 1/4 Watt
D1 - Diode Bridge, 1A, 50 Volts
C1 - Capacitor, 100 Mf, 20 VDC
R2 - Resistor, 51 Ohms, 1/2 Watt
Z1 - Zener Diode, 7.5 Volts, 1 Watt
LED1 - Light Emitting Diodes (Source)
R3 - Resistor, 2 M-Ohms, 1/4 Watt
PT1 - Photo Transistor (Sensor)
R4 - Resistor, 300 Ohms, 1/4 Watt
R5 - Resistor, 68 K-Ohms, 1/4 Watt
ST1 - Switching Transistor
REL1 - Relay - SPDT