

Tradesman DC Variable Speed Bench Grinder

Operator's Manual



Tradesman Woodturner



Tradesman Edge



Tradesman Machinist

CUTTERMASTERS

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TAKE CONTROL OF YOUR TOOLS



Revised March 12 2021

INTRODUCTION

Forward

Congratulations on your purchase of the Tradesman DC Variable Speed Bench Grinder. All Tradesman Grinders feature the same 400W DC Motor and control and plug in to regular household 110V AC current (220V available).

We have a patent on low speed high feed grinding with the Tradesman (variable speed, high torque and super abrasive wheels). The Tradesman is the only grinder designed to run plated-bond wheels. It is not like using other grinders, period. With the Tradesman you can grind carbide tools or Teflon on the same wheel because at 500 RPM, there's nothing threatening about it: you can take heavy cuts while keeping the heat down.

Enjoy your new grinding experience. Give us a call if you have any questions.



Contact Info

If you have any comments regarding this manual, service questions or parts requests, please contact us at the address below

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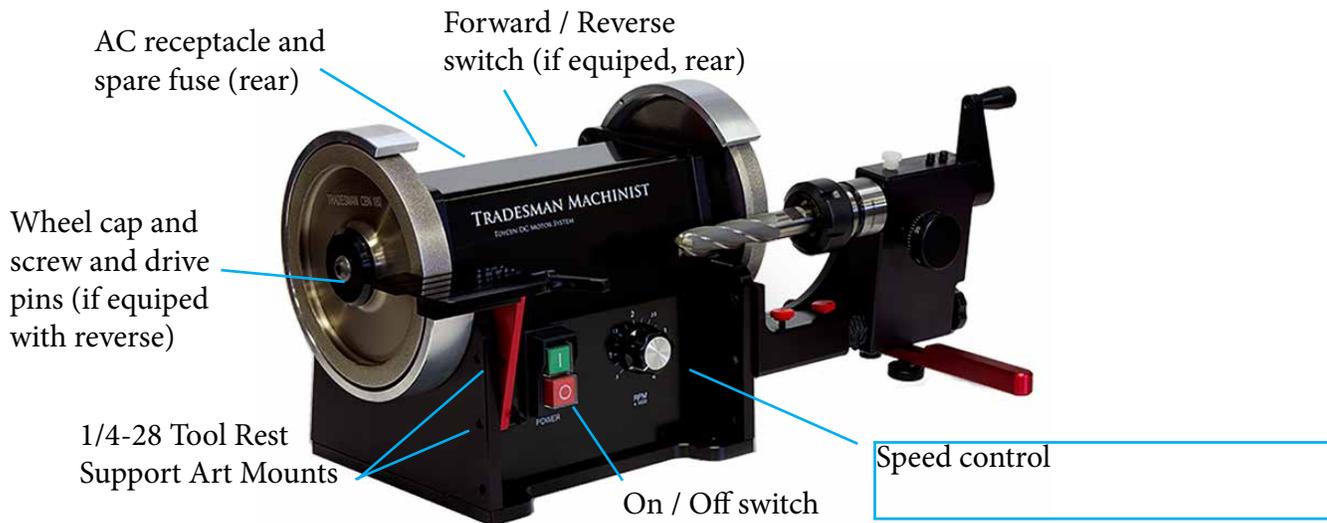
Revised February 13 2021

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Quick Start Guide



ON/OFF

The ON/OFF power switch is located on the front of the grinder. It has a safety feature to default to the Off position when every power is disconnected.

1. Turn the speed dial to minimum setting before turning the grinder on.
2. Press the green button marked with a vertical bar to turn the grinder on.
3. Press the red button marked with a circle to turn the grinder off.

Reverse (if equipped)

The reverse switch is a three position rocker switch where up is forwards, down is reverse and the middle position cuts power to the motor ie. the grinder will appear to be off (on switch will remain engaged) and wheels will not turn. **Important:** Do not go from forwards to reverse or vice versa while wheels are turning, this could damage the circuit board. Wait for wheels to stop turning before you change wheel direction. See page 7.

Wheel Guards

Wheel guards are precision machined and secured to the grinder with two socket head cap screws. These screws can be loosened to readjust the guard if it is rubbing on the grinding wheel, or removed to reposition the guard to it's open-at-top position for Tormek.

Drive Pins

Tradesman Grinders equipped with reverse feature drive pins (3/16" diameter pins) that fit through the wheel cap and into a receiving hole in the motor shaft. This ensures that hub caps and screw don't loosen during operation. If you have a reverse machine, always check that these pins are in place before you start. See page 6.

Fuses

The Tradesman Grinder uses a 8A Slow Blow fuse. It is located at the back of the machine inside the AC receptacle. It can be accessed by removing the power cord and prying the drawer out. The grinder ships with a spare fuse also in this location. See page 7.

Red Caps are used to indicate adjustment points.

WARNING!

This manual provides critical safety instructions on the proper setup, operation, maintenance and service of this machine.

Failure to read, understand and follow the instructions given in this manual may result in serious personal injury, including amputation, electrocution or death.

The owner of this machine/equipment is solely responsible for its safe use. This responsibility includes but is not limited to proper installation in a safe environment, personnel training and usage authorization, proper inspection and maintenance, manual availability and comprehension, application of safety devices, blade/cutter integrity, and the usage of personal protective equipment.

The manufacturer will not be held liable for injury or property damage from negligence, improper training, machine modifications or misuse.

DUST

Some dust created by power sanding, sawing, grinding, drilling, and other construction activities contains chemicals known to cause cancer, birth defects or other reproductive harm. Some examples of these chemicals are:

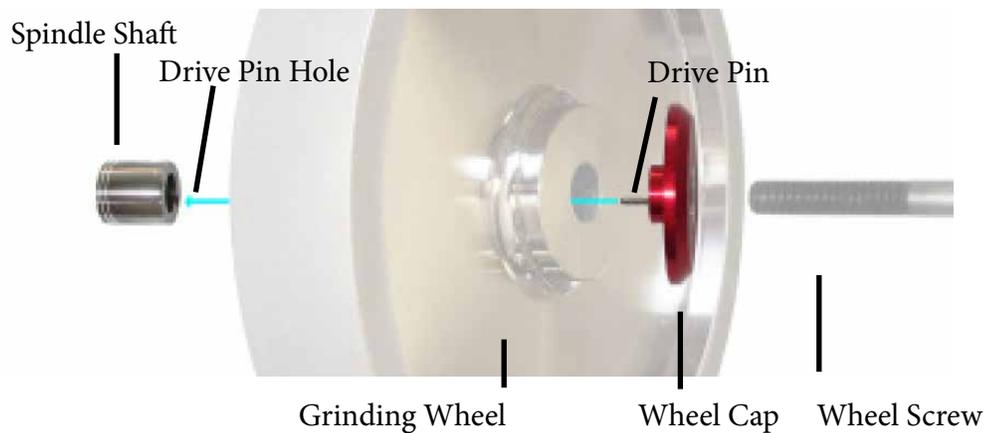
- Lead from lead based paints
- Crystalline silica from bricks, cement and other masonry products
- Arsenic and chromium from chemically-treated lumber.

Your risk from these exposures varies, depending on how often you do this type of work. To reduce your exposure to these chemicals: Work in a well ventilated area, and work with approved safety equipment, such as dust masks designed to filter microscopic particles.

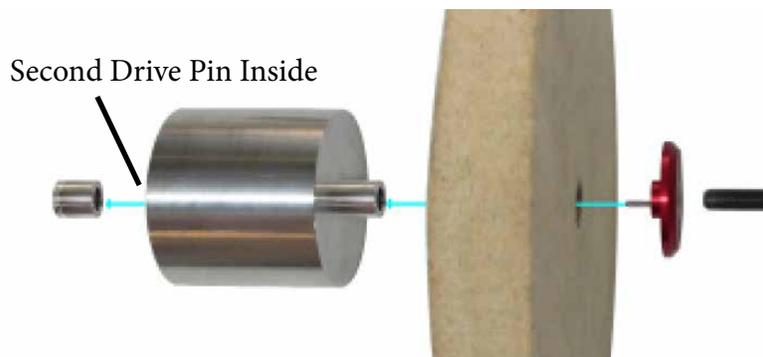
DRIVE PINS

Drive Pins: On all Tradesman Grinders with Reverse capability (have a reverse switch on rear of machine - see following page) drive pins are employed to secure the wheels to the shaft.

They pass through the cap and in to the shaft and stop the cap from accidentally unscrewing resulting in a wheel coming off during operation. Before use make sure that each wheel and cap has its drive pin installed. Do not operate the grinder without drive pins installed. Failure to do so could result in a grinding wheel coming off during operation. See the below diagram for a review of the drive pin operation.



When using the shaft extension, two drive pins are employed: one that locks the cap the extension and one that locks the extension to the spindle shaft.



FUSES and REVERSE ⚠

Fuses: All Tradesman grinders are equipped with a fuse inside the AC receptacle at the rear of the machine. If a power surge is experienced this fuse is designed to blow at 10A (10A Slow Blow). If your grinder isn't turning on when plugged in to a good power source this is the first place to look. The fuse can be accessed by unplugging the power cord from the grinder and finding it in a small drawer inside the receptacle. The drawer can be levered out with a small flat head screw driver. The drawer also contains a spare fuse.



Reverse Switch: If your grinder is equipped with a reverse switch note that it is a three position rocker switch where up is forwards, down is reverse and the middle position cuts power to the motor ie. the grinder will appear to be off and wheels will not turn.

Important: Do not go from forwards to reverse or vice versa while wheels are turning, this could damage the circuit board. Wait for wheels to stop turning before you change wheel direction.

GENERAL GRINDING SAFETY

For your own safety, read this instruction manual before operating this machine.

1. Always use ANSI approved safety glasses when operating machinery. Everyday eyeglasses only have impact resistant lenses - they are not safety glasses.
2. Always wear a NIOSH approved respirator when operating machinery that produces dust. Most types of dust (wood, metal, etc.) can cause severe respiratory illnesses.
3. Always use hearing protection. Machinery noise can cause permanent hearing loss.
4. Wear proper apparel. Do not wear loose clothing, gloves, neckties, rings, or jewelry that can catch in moving parts. Wear protective hair covering to contain long hair and wear non-slip footwear.
5. Never operate machinery when tired or under the influence of drugs or alcohol. Be mentally alert at all times when running machinery.
6. Do not overtighten spindle nuts. Overtightening these may cause the wheel to run out. Caps should be snug.
7. Adjust tool rests whenever necessary to maintain a distance of 1/8" (3.2mm) from the grinding wheel.
8. Keep wheel guards in place and working properly
9. During each start up, stand to one side of the grinder and switch it 'On'. Let the grinder run for 60 seconds to detect any flaws.
10. Always ensure that the work area is clear of any flammable materials, liquids or gasses, because the use of this tool may create sparks.

No list of safety guidelines is complete. Every shop is different. Always consider safety first, as it applies to your individual working conditions. Use this machinery with caution and respect. Failure to do so could result in serious personal injury, damage to equipment, or poor work results.

GENERAL ELECTRICAL SAFETY



Before You Start - Electrical

In the event of a malfunction or short circuit, grounding provides the path of least resistance for electrical current, and reduces the risk of electric shock for the operator. This tool is equipped with an electric cord that has an equipment grounding conductor and a grounding plug. The plug **MUST** be plugged into a matching outlet that is properly installed and grounded in accordance with ALL local codes and ordinances.

DO NOT MODIFY THE PLUG PROVIDED. If it will not fit the outlet, have the proper outlet installed by an electrician.

IMPROPER CONNECTION of the equipment grounding conductor can result in increased risk of electric shock. The conductor with the green insulation (with or without yellow stripes) is the equipment grounding conductor. If repair or replacement of the electric cord or plug is necessary, **DO NOT** connect the equipment grounding conductor to a live terminal.

CHECK with a qualified electrician or service personnel if you do not completely understand the grounding instructions, or if you are not sure if the tool is properly grounded.

Use of Extension Cords

USE ONLY THREE-WIRED EXTENSION CORDS that have 3-prong plugs and 3-holed outlets that accept the tool's plug. Repair or replace damaged or worn cords immediately.

Be sure your extension cord is properly wired and in good condition. Do not use damaged extension cords. Always replace a damaged extension cord.

When using an extension cord, be sure to use one heavy enough to carry the current your product will draw. An undersized cord will cause a drop in line voltage, resulting in loss of power and overheating. The table below shows the correct size to use according to the cord length and the amperage draw of the tool (specified on the nameplate). When in doubt, use the next heavier gauge. The smaller the gauge number, the heavier the cord. (AWG = American Wire Gauge).

Before You Start - Electrical (continued)

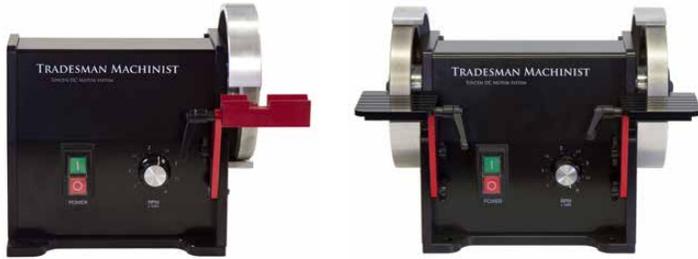
Use a separate electrical circuit for your tools. This circuit should not be less than a #12 gauge wire, and should be protected with a 15A time-lag fuse or breaker. Before connecting the motor to the power line, ensure the switch is in the OFF position and the electric current is rated the same as the current stamped on the motor's nameplate. Running at a lower voltage will damage the motor, and this damage is not covered by warranty.

Extension Cord Amps Ratings				
Length in Feet	16 AWG	14 AWG	12 AWG	10 AWG
25	13 A	15 A	15 A	30 A
50	13 A	15 A	15 A	20 A
100	10 A	13 A	15 A	20 A

KNOW YOUR GRINDER

Tradesman Machinist

Tradesman Machinist 6" Single or Dual Wheeled Bench Grinder designed for machinists: tool modifications like carbide cut off, neck reduction, Weldon set screw flats, carbide corner prep.



Tradesman Woodturner

Tradesman Woodturner 8" Grinder for woodturners and woodworkers. Designed to run 8" and 6" wheels and is compatible with popular jigs like the Wolverine jig and the Tormek jigs.



Tradesman Edge

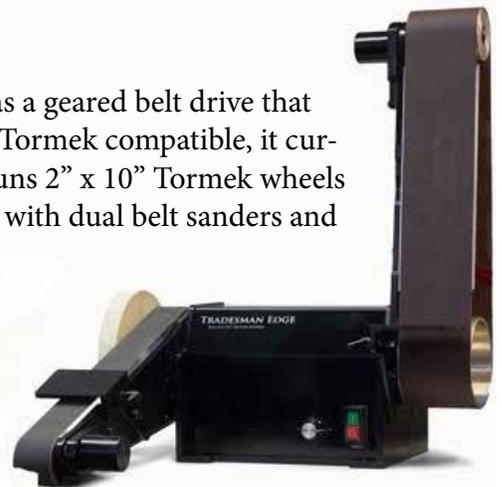
The Tradesman Edge differs from other Tradesman Grinders because it has a geared belt drive that increases the torque and lowers the minimum speed. Also Wolverine and Tormek compatible, it currently has three versions: Edge 810 runs 8", 10" wheels or belts; Edge 12 runs 2" x 10" Tormek wheels with 12 mm shafts and water bath or belt sanders; Both can be configured with dual belt sanders and felt wheel.



8" and 10" Wheels



Tormek Water Bath Kit



Dual Belt Felt

2. GENERAL SET UP

2.1 Mounting the Grinder to the Workbench

Before attempting to use this grinder, it should be properly mounted to a workbench or grinding stand. **CAUTION** Bench grinders vibrate. Grinder movement during high-speed rotation may cause injury or damage to the workpiece or operator. Mount the grinder securely to a sturdy workbench or grinding stand.

1. Position the grinder on the workbench.
2. Mark the workbench through the two mounting holes located in the grinder base.
3. Drill holes in the workbench at the marks.
4. Using two long bolts, washers, locking washers and nuts (not supplied), secure the grinder to the workbench.

2.2 Mounting the Wheels

Wheels are mounted using a 3/8-24 button head cap screw. That screw is a left hand thread on the left side (turn clockwise to loosen), and right hand thread on the right side.

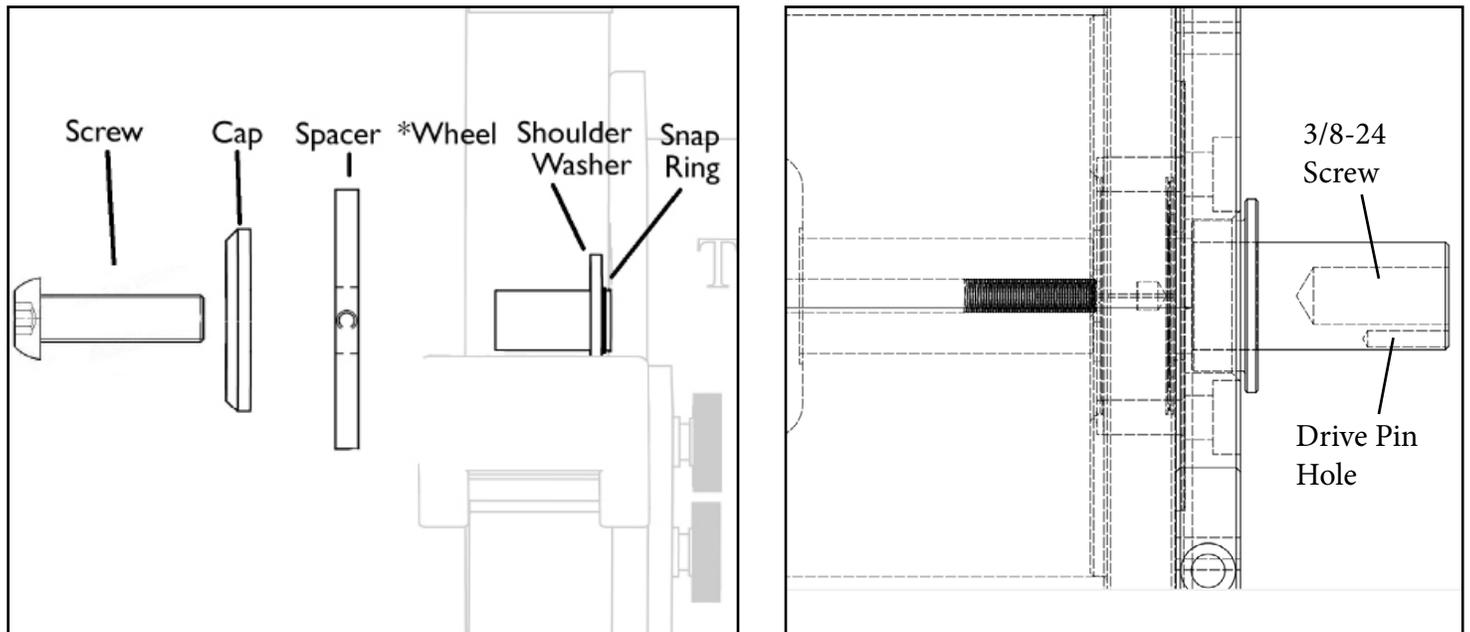
Be sure that the flat 5/8" washer is always used between the wheel and the snap ring. This washer prevents the wheel from pushing the snap ring over and contacting the grinder (see following diagram).

Your Tradesman has the largest possible shaft that can be fit into a motor this diameter and still have room for brushes. The shaft diameter internally is 0.6875" and ground down at final assembly to 0.6248" for a 5/8" arbor and close-to-zero runout.

Given this engineering circumstance, the shaft mounts an extra heavy duty snap ring in place of a shoulder. This snap ring is good for 1400 lbs of shear when shouldered with a strong, precise bore that is just slightly larger than the shaft by 0.0004". There is NO countersink on the face that bears against the snapping allowing it to develop maximum shear. See the following diagram.

Care should be taken to ensure that only factory certified washers come in contact with the snap ring. The 3/8"-24 button head wheel bolts are designed to apply the appropriate resisting force to drive the wheels on your grinder.

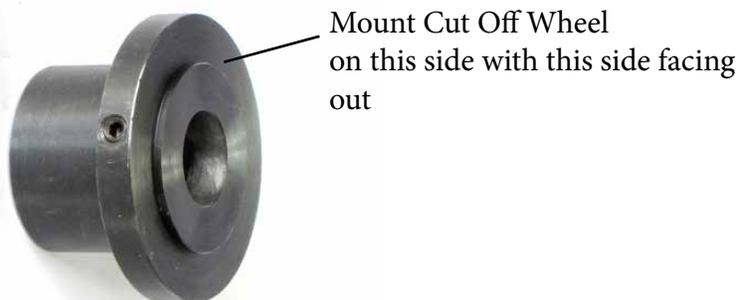
Tradesman DC Variable Speed Bench Grinder --- User's Manual



Wheel Mounting Hardware Orientation

Tool Grinder Hub

This hub is used to adapt the 5/8" shaft of the Tradesman to a 1.25" tool grinder hub to mount our machinist and specialty wheels. The hub is reversible: mount thicker wheels with the hub oriented with the flange inside, and thinner wheels like the cut off wheels, with the flange outside. This exposes the shorter 1.25" hub.

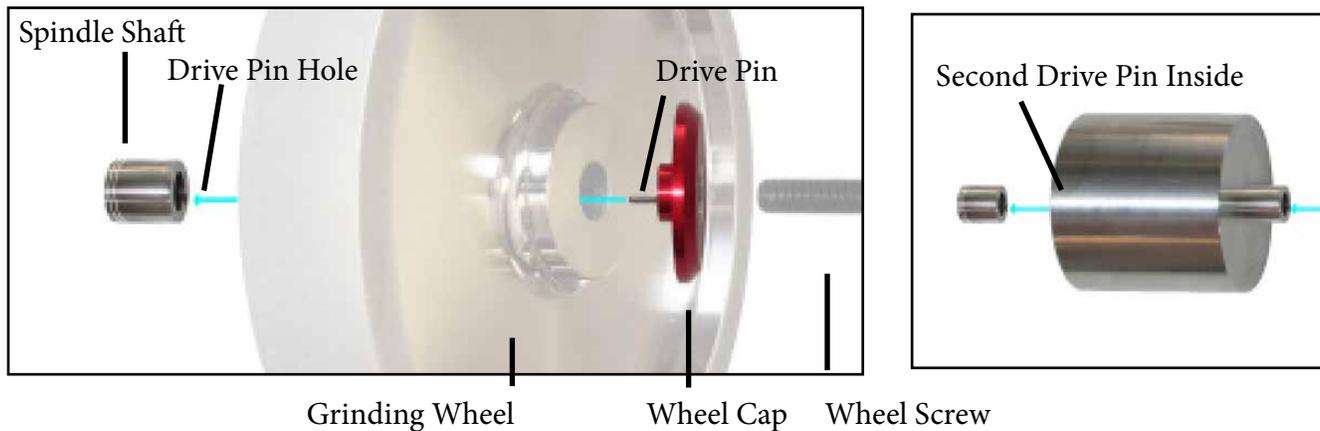


DRIVE PINS

2.3 Drive Pins

On all Tradesman Grinders with Reverse capability (have a reverse switch on rear of machine - see following page) drive pins are employed to secure the wheels to the shaft.

They pass through the cap and in to the shaft and stop the cap from accidentally unscrewing resulting in a wheel coming off during operation. Before use make sure that each wheel and cap has its drive pin installed. Do not operate the grinder without drive pins installed. Failure to do so could result in a grinding wheel coming off during operation. See the below diagram for a review of the drive pin operation.



When using the shaft extension, two drive pins are employed: one that locks the cap the extension and one that locks the extension to the spindle shaft.

2.4 Shaft Extension T-SE

The 2-1/2" long spindle extension can be used for felt buffing wheels. It is designed to fit over inner profile of an 8" Tradesman Plated Grinding Wheel. It can be used on either side and requires a long 3/8-24 scw to reach through the extension to the motor shaft and that would be a left hand thread on the left side of the grinder. To install remove wheel cap and screw from wheel and place the extension securely over the wheel. Mount felt or paper wheel with long wheel screw.



2.5 Tool Rest Adjustments and Installation

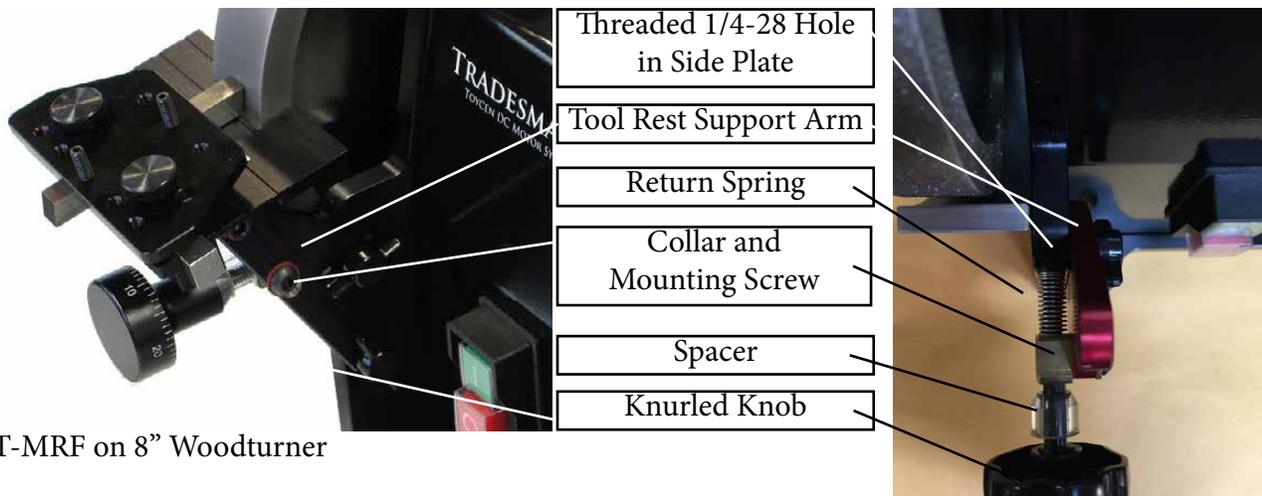
Tool rest adjustment is achieved using thumb screw and or button head cap screw and included hex key. Before tightening the screws, adjust the gap between the grinding wheel and the work rest to a maximum of 1/8th" (3.2 mm). Tighten securely. To prevent the workpiece from being pulled and caught between the tool rest and the wheel, readjust the tool rest position whenever necessary to maintain the 1/8th" (3.2 mm) distance.

The Tradesman Grinders feature 1/4-28 mounting holes in the side plates for mounting various attachments. Your Tradesman is supplied with four 1/4-28 Socket Head Cap Screws with dual-lobed thumb screws for toolless use. These can be replaced with any 1/4-28 screw. The bottom one is a pivot post while the top one is used to lock the arm at a certain swing position. Tighten each according to your needs.

Standard Rest, Mitre Rest Jig Plate (T-MRJ) and Mitre Rest Jig Plate with Feed (T-MRF)

The standard rest, the Mitre Rest and the Mitre Rest with y Axis Feed all mount similarly to a tool rest support arm with a ratchet lever arm. **Note:** On the Tradesman Machinist the support arm is red to show it is shorter than the Tradesman 8, due to the smaller wheel diameter on the Machinist.

T-MRF uses a unique tool rest support arm that mounts a 1/4-28 lead screw assembly. The T-MRF is the T-MRJ with the addition of the feed assembly.



T-MRF on 8" Woodturner

V-Block for Flats (T-WF)

The V-Block is mounted like the other rests using the 1/4-28 lever ratchet. It is designed to quickly put Weldon set screw flats into carbide end mills. Care should be taken to secure the tool to the V-Block with a clamp so that it doesn't shift during grinding. Tension the pivot screw and swing screw on the support arm sufficiently so that there is minimal play while allowing the tool rest to swing the V-Block forward to make the flat. The V-Block isn't designed for carbide cut off so be sure to clamp the tool if performing this operation.

2.6 Tormek

Tormek Bracket (T-TB, TE-TB for Edge)

Remove the standard tool rest support arms to mount the Tormek Bracket which has its own longer support arms. You can use the same mounting screws as used on the standard rests.

Note: For most Tormek jigs the wheel guards probably need to be repositioned so that the opening is at the top of the wheel. If not equipped with thumb screws, the wheel guard is mounted with two socket head cap screws and your grinder should be supplied with a 9/64ths hex key for these screws.



Universal Rest for Tormek Attachments

There are several options for your tool rest for Tormek attachments that are set the same way, with red locking set screws in the bracket. Use your official Tormek US-105 Support, The similar Tradesman support (T-US105), the 26" Tradesman Edge Twin Support (TE-US105), or the short 6" bar rest (T-BR) which mounts without the Tormek Bracket using a 1/4-28 screw.



T-US105



T-BR Bar Rest

Water Bath Kit

The Tradesman Edge can be equipped with a water bath kit similar to that used on the Tormek machines. These water baths are machined to hook on the the side of grinder and lift off for easy removal. This requires that the grinder be sitting on a riser to provide the clearance to drop the water bath. Wheel guard is removed. RPM should be kept to minimum.



2.7 Belt Sanders

Tradesman Belts Sanding Attachments are precision machined for the best belt sanding experience. These attachments are compatible with all models of Tradesman grinder and are designed to be easy to use in both directions. The Belt over wheel attachment is unique because it uses a Tradesman 8" CBN plated wheel as the drive wheel. Tensioning, adjustments and belt installation are similar for all of the belt sanding attachments.



4" x 48"



2" x 48"



2" x 36"



1.25" x 48" Belt Over Wheel

Diagram



Tensioning the Belt Sanding Attachment Frame

The drive wheel of the belt sanding attachment has three holes used to pass the hex key through to the tensioning screws on the inner belt assembly. Tighten each screw incrementally until desired tension is reached. Belt-Over-Wheel adjustment is the same but necessary to remove grinding wheel.



2.7 Belt Sanders (Continued)

Installing an Abrasive Belt

Check to see if your belt has directional arrows and observe any manufacturer recommendations. Turn the grinder off. With one hand, grasp the tensioning handle, opposite the upper pulley and rotate it towards you. This will release tension on the belt for installation. With your other hand center the belt over both pulleys and release the tension handle. Roll the belt in your desired direction by hand to check the tracking before you turn on the grinder. Once the belt tracking is set so that the belt stays on the pulleys over several rotations it is safe to turn on the grinder in your desired direction.

If static electricity is experienced around the belt, try applying foil tape to the smart platen. Remove Teflon tape before applying the foil tape.



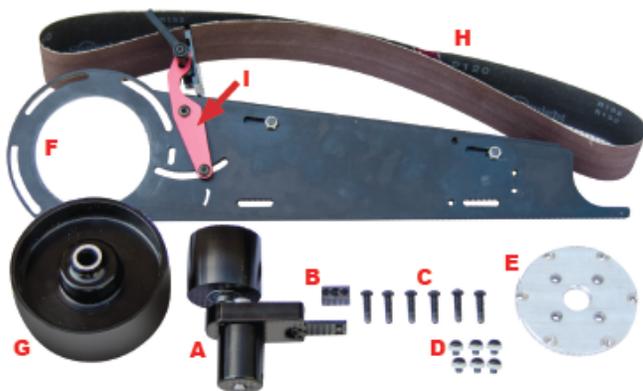
Tracking the Belt Sanding Attachment

Use the supplied hex key to adjust the tracking set screw.

Reversing the Belt Sanding Attachment

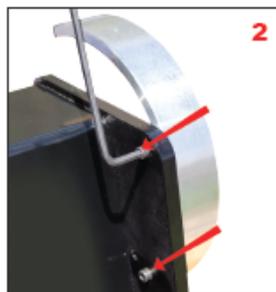
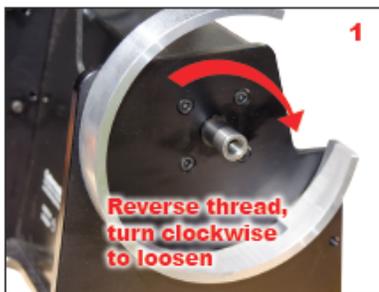
If your grinder is equipped with the reverse feature --- Check to see if your belt has directional arrows. Turn off the grinder and run the belt in the reverse direction by hand to see if the tracking needs to be adjusted. If so, use the supplied hex key to adjust the tracking set screw. Once the belt tracking is set so that the belt stays on the pulleys over several rotations by hand it is safe to turn on the grinder in your desired direction. Fine tune tracking using 1/8 turns of the set screw.

2.7 Belt Sanders (Continued)



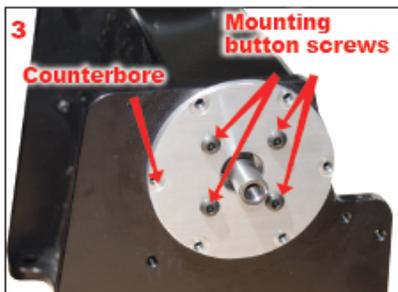
Parts:

- A. Upper pulley wheel assembly
- B. Upper pulley spacer
- C. 6 long button head screws
- D. 6 angle adjustment screws
- E. Mounting plate
- F. Side plate
- G. Lower pulley wheel
- H. Sanding belt
- I. Steady rest arm



1. Remove grinding wheel from left side of unit. Grinder left side screw is a left handed reverse thread, turn clockwise to loosen.

2. Remove grinding wheel guard from left side of grinder by removing the two screws holding the guard in place.



3. Mount the supplied mounting plate to the grinder with the counterbore facing outward, using the 4 long button screws supplied with the belt sander.

4. Tighten securely.

Note that some Tradesman grinders have a 2mm step after the snap ring. If yours has a step, remove the snap ring and use the provided spacer.

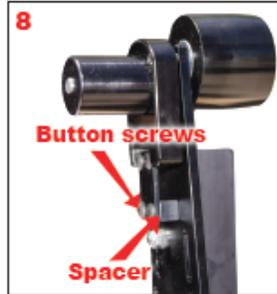
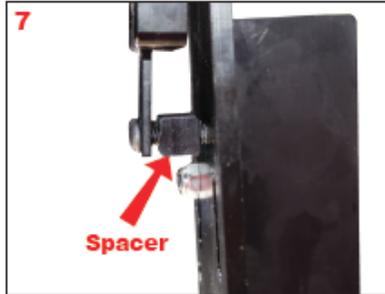


5. Lightly snug the side plate to the grinder using the 6 angle adjustment button screws with nylon washers supplied with the belt sander. Do not tighten.

6. Adjust to desired angle and snug to a secure fit. Do not overtighten.

Note that we use three adjustment screws instead of six, step 5.

2.7 Belt Sanders (Continued)



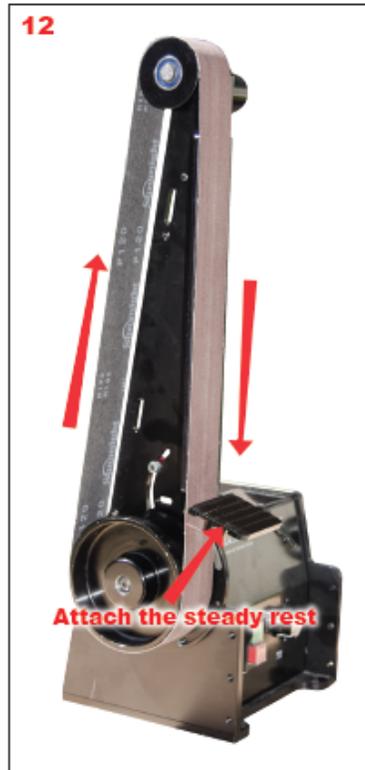
7. While holding spacer between top pulley and side plate, screw a button screw through the pulley bracket, spacer, and into the side plate.

8. Insert second button screw and secure the top pulley wheel to side plate.



9. Slide the lower pulley wheel on to grinder shaft, be sure to rotate pulley wheel until the wheel seats all the way in and locks into place on the set pin on the shaft.

10. Secure lower pulley wheel with large button screw that was used to hold on previous grinding wheel. Grinder left side button screw is left hand reverse thread. Hold the lower pulley with one hand and tighten button screw counterclockwise to secure the lower pulley. Do not over-tighten. Overtightening can cause runout.



11. Mounting the sanding belt around both pulleys: First look on inside of belt for directional arrows. Make sure the arrows match the illustration on left. Place belt over lower pulley wheel first and then with other hand twist outer handle on upper pulley assembly counterclockwise, slide belt over upper pulley wheel and release outer handle for tension.

12. Using the two included screws, attach the steady rest in your desired location on the side plate.

Your belt sander is now ready to use.

2.8 Belt-Over-Wheel Belt Sander Assembly

To install the Belt-Over-Wheel Attachment you will need:

- four 1/4"-20 x 3/4" button head cap screws to mount the pivot plate (4" diameter round plate) to the grinder
- three 1/4"-28 x 3/8" each with two red fibre washers to secure the main sander plate to the pivot plate
- the belt spacer 1-1/2" diameter, 3/8" thick, 5/8" arbor (shown in the very middle).



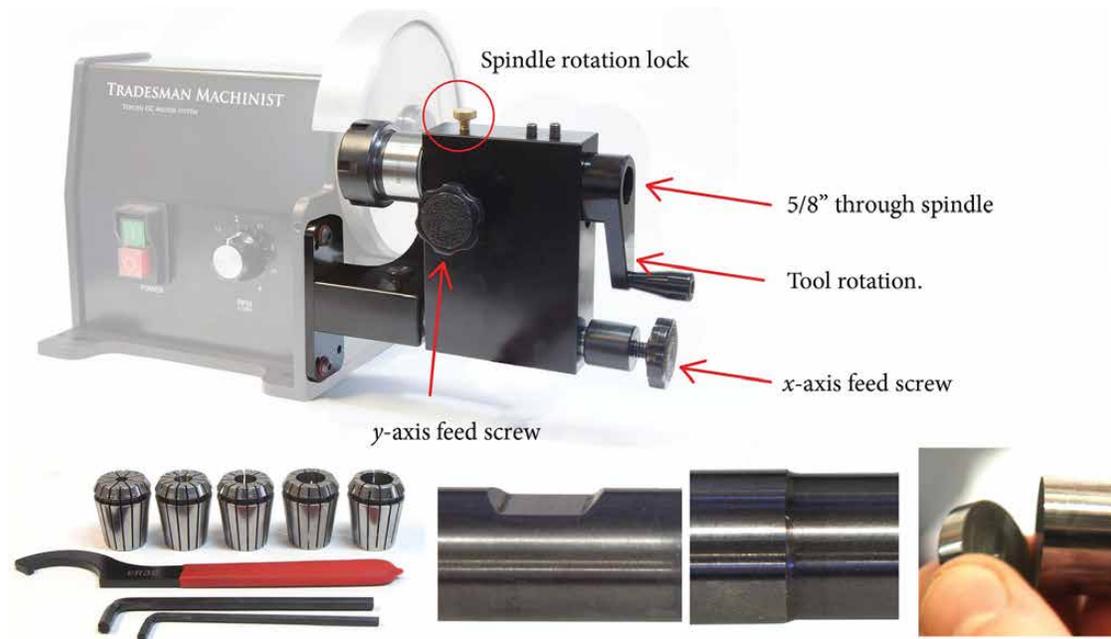
Belt-Over-Wheel Mounting Hardware

1. Remove the wheel guard, grinding wheel and snap ring from motor shaft (you might need a pair of snap ring pliers).
2. Remove the four 1/4"-20 socket head cap screws from the side plate of the grinder (these secure the motor to the grinder side plate and will be replaced with the four 1/4"-20 *button heads*). Keep the socket heads for reassembling the grinder without the belt sander.
3. Mount the pivot plate with the four button heads.
4. Install the spacer by sliding it on to the motor shaft.
5. Mount the main sander plate with the three 1/4"-28 button heads. These can be snugged to allow the belt to pivot while still rigid enough for sanding.

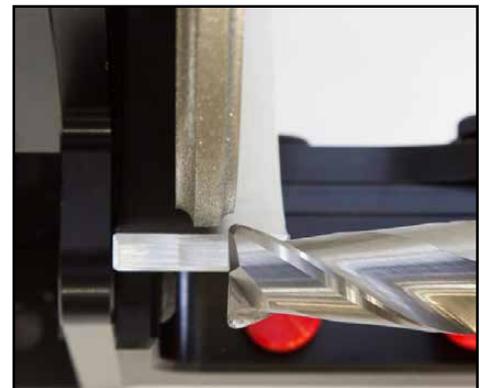
3. Tradesman Machinist Attachments

3.1 End Mill Workstation, T-ER32i

The T-ER32i is designed to grind neck reductions on the Tradesman Machinist. It is also a great tool for carbide cut off, sharpening reamers and grinding Weldon set screw flats. It can also be used for grinding corner rads on carbide tools - due to the precise requirements of this operation, corner rads require the grinder be specially set up at the factory. Remove the tool rest support arm on the side of the grinder you will install the T-ER32i. The T-ER32i mounts to these holes from the outside face of the side plate using supplied 1/4-28 button head cap screws.



Spindle can be locked, spun freely or indexed to several positions around the tool using the upper set screws. Use the x-axis feed screw for positioning. Use the y-axis feed screw to feed in to the wheel for flats, cut off and neck reduction. Cuttermasters Chamfer Wheels are used for grinding Weldon set screw flats and can also be used for sharpening reamers. Use Cuttermasters shoulder wheels for neck reduction and creating T-slot cutters.



Carbide Corner Prep using Profiled Radius Wheel

3.2 Unibit Attachment, T-Unibit



The Tradesman Machinist can be configured to mount a fence ideal for sharpening unibits. It is used with the Tradesman Unibit Grinding Wheels.

1. Set depth of cut adjustment. Position three setscrews so that the unibit fence is at desired depth of cut.
2. Tighten the two mounting bolts to secure the unibit fence to Tradesman side plate.
3. Position the unibit. Away from the wheel, press and hold unibit against the bottom and outer face of the fence.

Tradesman 6" Machinist with T-Unibit Fence, T-6180U Unibit Wheel, Brass wire wheel

4. Grinding. While maintaining light pressure against the fence, slide the unibit back and forth past the wheel. Each pass should remove a couple of thousandths of an inch. Repeat until inside face of the unibit is evenly ground to the cutting lip - a few passes should do it.

5. Removing the burr. This sharpening process will produce a small burr on the outside of the cutting lip. Remove this burr to complete the sharpening process. A quick pass of a wire brush works well.

3.3 Countersink and Step Drill Attachment T-DCS



The T-DCS is designed to use the CM-06DCS Drill and Countersink Attachment on the Tradesman by mounting it on a feed plate that is mounted to the 1/4-28 attachment points on the side plate (remove tool rest support arms before installation).

The recommended wheel for drills and countersinks is the Cuttermasters 6" CBN Face Wheel.

Chuck capacity 3mm-21mm (1/8" - 7/8")

- Angle adjustment: 50° - (infinite on Journeyman)
- Unit size: 17cm x 13cm x 18cm x 10kg
- Grinds one and three flute countersinks
- Grinds drills and step drills



Countersink and Step Drill Attachment T-DCS (continued)

Countersink Sharpening

Radial cam follower is removed for countersink grinding. It is a plunge process only, that is governed by our slip-on cams. There is no swing.

The swing adjustment screw is used for fine angular adjustment.

Drill Sharpening

Remount the radial cam follower. Radial swing is used for drill grinding but is not needed for countersink grinding. Replace the cam follower and use the native cams that are on each chuck, when sharpening drills.

Tool Length

The tool should stick out far enough to clear everything during the grinding process, however not so far as to not be firmly placed in the chuck. The tool must be perfectly straight and tight in the jaws when grinding.

Timing

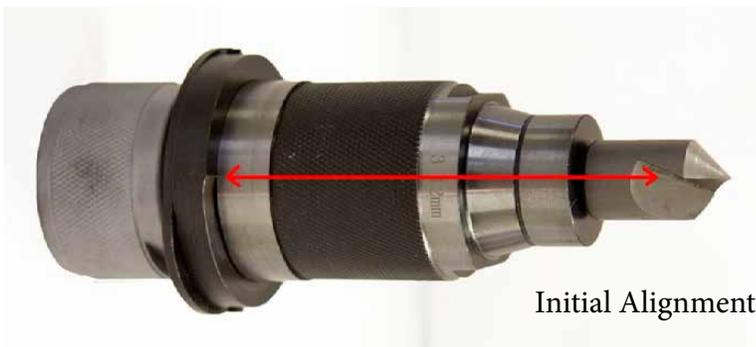
Hold the chuck in your hand with the tool inserted and facing you. Rotate it so that one of the cams is in the "twelve o'clock" position.

1-Flute Countersinks

The cutting edge of 1-flute countersinks will be at about "40 degrees ahead of the cam lobe intersection" if the top of the cam is at "twelve o'clock" (Figure 2). With 1-flute countersinks you should observe with the cam roller at the bottom of the plunge, or feed stroke (rotating it gently it will come to rest at the cam lobe intersection) the cutting edge of the tool is positioned around "seven thirty" (cam roller being at six o'clock) from the operators perspective .

As you continue to rotate clockwise the cam repositions the tool to bring the next cutting face to bear against the wheel. In other words, the full flute face ideally will be ground while not being so retarded that the full face does not clean during the swing and no so advanced that it takes the flute edge off at the point when entering the grind.

A different view Optimal Cutting Edge Position for 1-Flute Countersinks When Roller is at Bottom of Plunge



Countersink and Step Drill Attachment T-DCS (continued)

3-Flute Countersinks

When viewing the correctly timed tool as shown in Figure x, each flute of a 3 flute countersink will bisected by the top of the cam. (Figure 5).

Not all countersinks are the same.

Check your timing:

Bring the tool into the wheel with the motor off for observation.

Rotate clockwise to the bottom of the plunge you should be able to observe that the flute that you are at the end of the heel (lowest point of the grind. If the tool is too advanced it will produce a flat or grind off the tool at the tip pre- maturely. If this happens loosen the chuck slightly and retard the tool slightly in the chuck. At the end of the rotational swing the heel of the grind should just be leaving the wheel. A small flat at the back edge of the heel is better than a dull tip.

General operation and Timing:

Select the Cam of your choice , the cams just drop over the chuck and replace the plunge and swing profile of the basic chuck , and with the use od the swing lift knob change the operation into that of a plunge only action.

Timing the Tool

The roller that rides in the cam is underneath the chuck, it determines the axial travel. Therefore, one must keep pressure on this during the grinding process. Tighten the tool in the chuck snug but so that you can rotate it .with the Side set screw adjusted so that the swing cam is just so the swing cam lobe doesn't hit the roller when the chuck is rotated.

Match up the angle to be ground, and check to see if there is feed using the feed knob.

Rotate the assembly with the roller and cam in contact with each other bring the tool/chuck so that it has completed a plunge cycle, the tool will draw back slightly.

Now time the tool, it has just finished the grinding stroke. At this point rotate the tool in the chuck so it is now entering the next flute and tighten in the chuck.

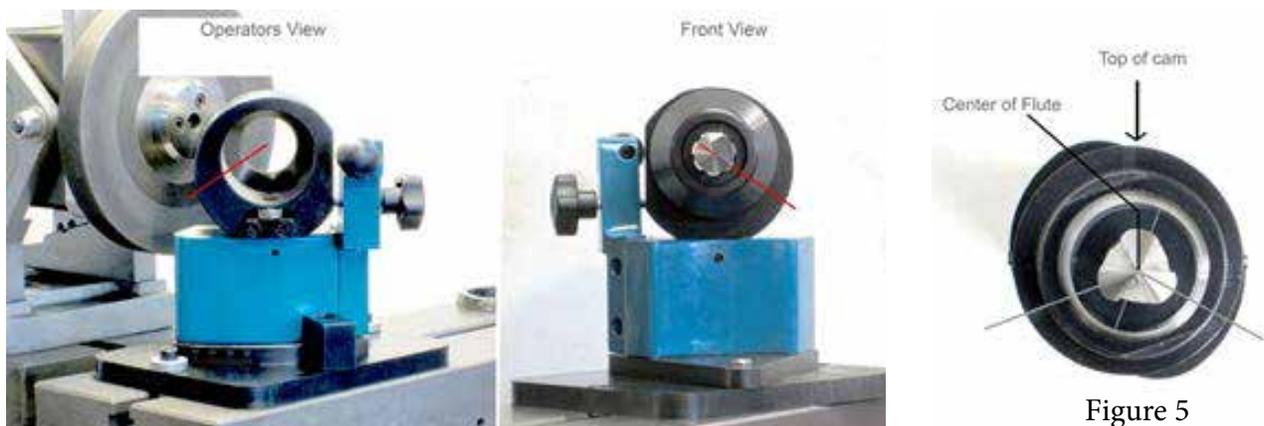


Figure 5

Countersink and Step Drill Attachment T-DCS (continued)

Dry run the grinding cycle by rotating the chuck and observing the angle, entrance and exit point (with the motor off) to see if you are getting the grind that you desire. Once you are satisfied with the cycle behavior turn on the grinder, remove the chuck and make sure it is tight and all settings are tight.

Proceed, light cuts, be sure to observe the original clearance angle and try and replicate your grind so it's a good match to the original, change cams if more or less lip clearance is needed.

The Grinding Process

It is important to realize if the cutting lip hits the wheel first, since there is not much material there it will overgrind if one is not careful. Therefore, always spend time removing material from the heel (the area behind the cutting lip) and then only grind the lip as a light cut after all of the clearance work has been done.

All countersinks are different and there is usually some proprietary shape that we will never know the details of. The CM06 cams have been designed to be the best MEAN shape for sharpening most countersinks. It is always up to the operator to try and achieve or replicate what he feels is best.

The most common mistake is not achieving proper clearance. To that end always test the countersink location in the middle of the heel not the lip. Be aggressive when removing heel material.

4. Maintenance and Troubleshooting

Maintenance

WARNING! Turn the power switch to “OFF” and disconnect the plug from the outlet prior to adjusting or maintaining the grinder. **DO NOT** attempt to repair or maintain the electrical components of the motor. Take the grinder to a qualified service technician for this type of maintenance.

It is important to routinely check that the set screw on the hub is tight and also that the three hub cap bolts are tight and the wheel is running true.

Trouble Shooting

Grinder will not turn on. Ensure there is power at the outlet and that your grinder is plugged in to it. Check that the fuse has not blown in the Tradesman. It is located in the socket of the AC receptacle at the back of the machine. First unplug the power cord and you'll see a drawer that will pull out with the aid of a small flathead screwdriver. The Tradesman is equipped with a spare fuse that can be found in this drawer as well. The fuses are 250V 8A slow-blow. Check reverse switch, if equipped, is not in middle (off) position.

Wheels are not running true (running out). This can be affected by loosening up the hub, rotating slightly (try ~70 degrees, or 1/5 of a rotation) on the shaft and re tightening the wheel. Over tightening may damage the shaft and may also contribute to the wheel running out. Repeat until you have gone around the entire wheel (360 degrees). If this does not fix it try flipping the wheel over, flipping the washer over, swapping left and right wheels.

Wheel balance. The wheels on the tradesman are balanced but they are large rotating masses that will vibrate the machine if minor mis-balances are aligned, or wheels are not running true. Loosen and alter the rotational relationship and retighten as described above for runnout.

Blown fuses. If the fuse is blowing when or shortly after the grinder is turned on it may be because the speed dial was at or above 75% (when using especially heavy wheels). This may also indicate an electrical problem, if it persists, and you should contact us to solve the problem for you.

Try turning the speed down to the minimum setting before turning the grinder on. The spare fuse is located in the socket of the AC receptacle at the back of the machine. First unplug the power cord and you'll see a drawer that will pull out with the aid of a small flathead screwdriver. The Tradesman is equipped with a spare fuse that can be found in this drawer as well. The fuses are 250V 8A slow-blow.

Static electricty around belt sander

If static electricity is experienced around the belt, try applying foil tape to the smart platen. Remove Teflon tape before applying the foil tape.

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The recommendations and suggestions regarding product application and use that are offered on Toycen websites, in our product brochures, or information provided by any employee, broker or distributor of Toycen products, are a guide in the use of this product and are not a guarantee to their performance since Toycen has no control over the use that parties may apply the product. Toycen recommends that operators and users of our products ensure that the intended use does not violate any Federal, State/Provincial, or Local laws; are within the described performance characteristics of the product, all Federal, State/Provincial workplace safety requirements are being complied with, and any product specific safety requirements are met. Meeting the above requirements is the sole responsibility of the user/operator of the product.

This Toycen product is designed, and intended, solely for the purpose of the removal of metal by grinding through the use of a rotating, abrasive coated wheel. It is not intended or designed for any other purpose. The product buyer, assignee, transferee and or user agree to use the Product for its intended purpose and designed use. This product is warranted against any manufactured defect for a period of 12 months from the original date of purchase.

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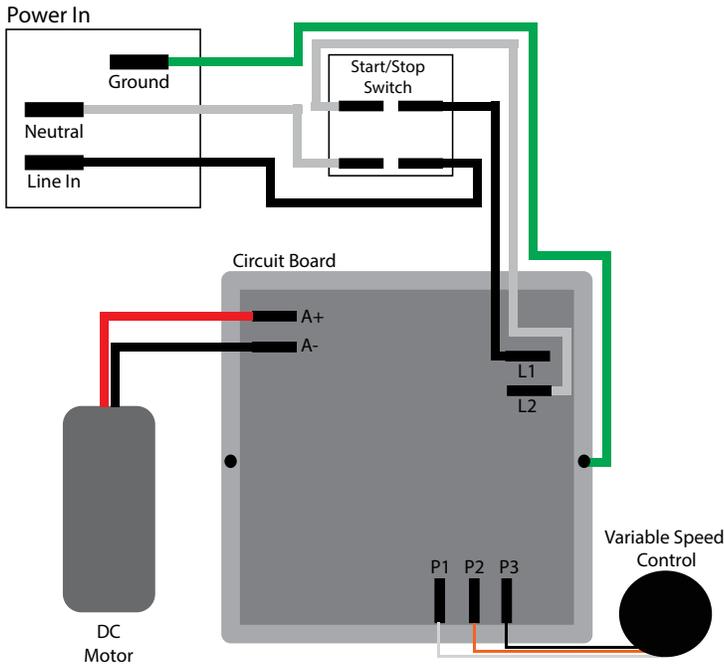
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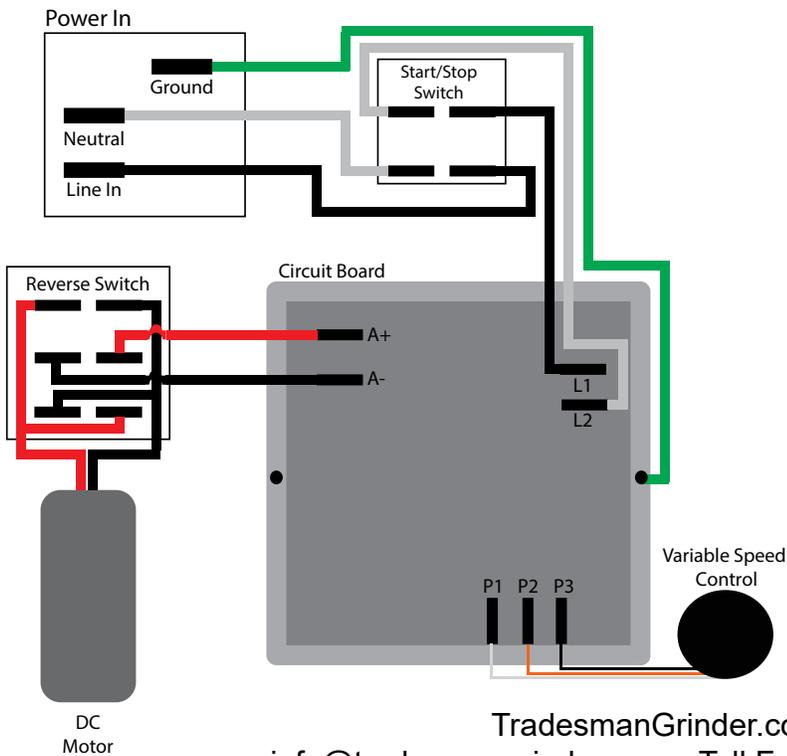
User acknowledges that activities involving potential uses of this product may be result in personal injury. Installation or other use of this product constitutes the user's acknowledgement that the user has read and understands the warnings, cautions, and Terms of Use & Disclaimer and that the user agrees and consents to the terms and conditions of this Terms of Use & Disclaimer; OTHERWISE, DO NOT INSTALL OR USE THIS PRODUCT.

6. Wiring Diagrams

Tradesman: Non Reversing



Tradesman: Reversing



Specifications

Tradesman Machinist, T6 and T6NC

Wheel Dimensions	6" diameter, .75" width (to guard), 1.25" or 5/8" arbor
Voltage, Frequency, Power	110V, 220V available, 60Hz, 400W, 1/3HP
Motor Type	Brushed DC, Single Phase
Switch	On/Off Push Button with Safety, 110V or 120V
Wheel Speed	500 - 4000 RPM
Height at 6" Guard	9.25"
Width at Outside of 6" Guard	10.8" Dual, 10" single
Depth at Base	8"
Wheel Center Height	5.5"
Shaft Diameter	5/8" , 1-1/4" hub
Shaft Concentricity	.0002" (5µm) nominal
Country of Origin	Canada, HTS#8460.39.0020
Warranty	Two Years

Tradesman Woodturner, T8

Wheel Dimensions	8" diameter, 1.25" width (to guard), 5/8" arbor
Voltage, Frequency, Power	110V, 220V available, 60Hz, 400W, 1/3HP
Motor Type	Brushed DC, Single Phase
Switch	On/Off Push Button with Safety, 110V or 120V
Wheel Speed	500 - 4000 RPM
Height at 8" Guard	
Width at Outside of 6" Guard	
Depth at Base	
Wheel Center Height	
Shaft Diameter	5/8"
Shaft Concentricity	.0002" (5µm) nominal
Country of Origin	Canada, HTS#8460.39.0020
Warranty	Two Years

Specifications (continued)

Tradesman Edge 810

Wheel Dimensions	8-10" dia., 2" width (to guard), 5/8" or 7/8" arbor
Voltage, Frequency, Power	110V, 220V available, 60Hz, 400W, 1/3HP
Motor Type	Brushed DC, Single Phase
Switch	On/Off Push Button with Safety, 110V or 120V
Wheel Speed	150 - 1500 RPM
Height at 6" Guard	
Width at Outside of 6" Guard	
Depth at Base	8"
Wheel Center Height	5.5"
Shaft Diameter	5/8" , 1-1/4" hub
Shaft Concentricity	.0002" (5µm) nominal
Country of Origin	Canada, HTS#8460.39.0020
Warranty	Two Years

Tradesman Edge 12

Wheel Dimensions	8-10" dia., 2" width (to guard), 5/8" or 7/8" arbor
Voltage, Frequency, Power	110V, 220V available, 60Hz, 400W, 1/3HP
Motor Type	Brushed DC, Single Phase
Switch	On/Off Push Button with Safety, 110V or 120V
Wheel Speed	150 - 1500 RPM
Height at 6" Guard	
Width at Outside of 6" Guard	
Depth at Base	
Wheel Center Height	
Shaft Diameter	12mm for Tormek wheels
Shaft Concentricity	.0002" (5µm) nominal
Country of Origin	Canada, HTS#8460.39.0020
Warranty	Two Years

Tradesman Edge Belt

Wheel Dimensions	8-10" dia., 2" width (to guard), 5/8" or 7/8" arbor
Voltage, Frequency, Power	110V, 220V available, 60Hz, 400W, 1/3HP
Motor Type	Brushed DC, Single Phase
Switch	On/Off Push Button with Safety, 110V or 120V
Wheel Speed	150 - 1500 RPM
Height at 6" Guard	
Width at Outside of 6" Guard	
Depth at Base	8"
Wheel Center Height	5.5"
Shaft Diameter	5/8" , 1-1/4" hub
Shaft Concentricity	.0002" (5µm) nominal
Country of Origin	Canada, HTS#8460.39.0020
Warranty	Two Years

Tradesman DC Variable Speed Bench Grinder --- User's Manual

Appendix

KB Control Board Manual

KBWD
PULSE WIDTH MODULATED
WHISPER DRIVE™
PWM DC MOTOR SPEED CONTROLS
For PM DC Motors

**INSTALLATION
AND
OPERATING
INSTRUCTIONS**

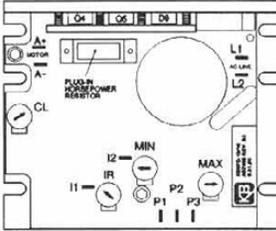
This Manual Covers the Following Models

MODEL NO.	PART NO.
KBWD - 13	8609
KBWD - 16	8607

See Safety Warning and Application Note Warning on Pages 1 and 2

PENTA KE POWER
A COMPLETE LINE OF MOTOR DRIVE

©1996 KB Electronics, Inc.



- Model No. KBWD-13 P/N 8609
Rated 3.0 amps DC @ 120 VAC 50/60 Hz
- Model No. KBWD-16 P/N 8607
Rated 5.0 amps DC @ 120 VAC 50/60 Hz

Appendix Figure 1

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Appendix Figure 2

i. SAFETY WARNING! - PLEASE READ CAREFULLY

This product should be installed and serviced by a qualified technician, electrician or electrical maintenance person familiar with its operation and the hazards involved. Proper installation which includes wiring, mounting in proper enclosure, fusing or other overcurrent protection and grounding, can reduce the chance of electric shocks, fires or explosion in this product or products used with this product, such as electric motors, switches, coils, solenoids and/or relays. Eye protection must be worn and insulated adjustment tools must be used when working with control under power. This product is constructed of materials (plastics, metals, carbon, silicon, etc.) which may be a potential hazard. Proper shielding, grounding and filtering of this product can reduce the emission of radio frequency interference (RFI) which may adversely affect sensitive electronic equipment. If information is required on this product, contact our factory. It is the responsibility of the equipment manufacturer and individual installer to supply this safety warning to the ultimate user of this product. (SW effective 11/92)

This control contains electronic Start/Stop and inhibit circuits that can be used to start and stop the control. However, these circuits are never to be used as safety disconnects since they are not fail-safe. Use only the AC line for this purpose.

The input circuits of this control (potentiometer, inhibit) are not isolated from AC line. Be sure to follow all instructions carefully. Fire and/or electrocution can result due to improper use of this product.

Appendix Figure 3

iii. APPLICATION NOTE: WARNING!

1. PWM controls are designed with power transistors wired directly in series with the motor. If for some reason this transistor short circuits, a "runaway" condition could develop where the motor will almost instantaneously accelerate to full speed. This could cause physical harm to an operator or user of the machinery or equipment on which the control is installed. In some cases a proper sized fuse, when installed in series with the motor armature, will prevent this "runaway" condition. Use extreme caution when applying PWM controls to certain applications. KB has available a protective device "PSM" which is designed to prevent "runaway".
2. PWM controls emit substantial levels of radio frequency interference (RFI) compared to SCR controls. KB has available RFI filters which will eliminate most of the RFI. However, RFI can still be radiated and conducted from the control and through the motor wires. Shielded cables and other means of reducing the effect of RFI may have to be employed for some applications.
3. This control may contain inhibit, enable and other circuits that can be used to turn control "on" and "off." **Do not use these circuits as a safety disconnect.** Use only the AC line for that purpose.

I. GENERAL INFORMATION

Product Description.

The KBWD Pulse Width Modulated (PWM) PM DC motor speed control provides excellent dynamic response to load variations. The efficient PWM waveform produces an almost pure DC current to the motor (form factor < 1.05) which has several advantages over a conventional SCR control. The PWM significantly lowers audible motor noise and provides longer brush life. It also produces less motor heating which allows a smaller, less costly motor to be used for most applications. Another advantage of PWM is higher output which provides increased output speed. In addition, the KBWD contains pulse-by-pulse current sensing which provides short circuit protection and prevents control damage due to shorted motors.

A unique feature of the KBWD control is the Plug-in Horsepower Resistor®, it eliminates the need for recalibrating IR Comp and Current Limit when the control is used on various horsepower motors. The control contains armature feedback which provides excellent load regulation.

The control contains quick disconnect terminals as standard. A potentiometer (5K), isolated analog signal (0-5 VDC), or PWM microprocessor output can be used to vary the output of the control.

Appendix Figure 4

Tradesman DC Variable Speed Bench Grinder --- User's Manual

TABLE 1 - SPECIFICATIONS

Parameter	Units	Specification	Factory Setting
Speed Range	Ratio	50:1	----
Operating Frequency	KHz	>16	----
Form Factor	amps RMS/amps DC	<1.05	----
Ambient Operating Temperature Range	°C	0 - 45	----
Load Regulation	% Base Speed	1*	----
ACCEL Range (Non-adjustable)	Seconds	0.2, 1, 2.5, and 6	2.5
MIN Trimpot Range	% Base Speed	0 - 40	0
MAX Trimpot Range	% Base Speed	80 - 140	100
CL Range	% Range Setting	0 - 150	150
IR COMP Trimpot Range	VDC	0 - 25	6
AC Line Voltage Regulation	% Base Speed	±0.5	----
Speed Potentiometer	KΩ	5	----

*Load regulation data is based on a motor having linear IR Comp. characteristics.

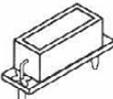
TABLE 2 - RATINGS

Model	AC Line Input Voltage (VAC-50/60Hz)	DC Output Voltage (VDC)	MAX DC Output Current (ADC)		MAX Motor Horsepower* (HP,(KW))
			@ 100 VDC	@ 130 VDC	
KBWD-13	120	0 - 130	3.5	3.0	1/3, (0.25)
KBWD-16	120	0 - 130	6.0	5.0	1/2, (0.35)

*Maximum Motor Horsepower is for 90VDC SCR Rated Motors and 130VDC PWM Rated Motors.

Appendix Figure 5

PLUG-IN HORSEPOWER RESISTOR®



CAUTION
Be sure Plug-in Horsepower Resistor® is inserted completely into mating socket.

A Plug-in Horsepower Resistor® must be installed to match the KBWD to the motor horsepower. See Table 2 for the correct value. Plug-in Horsepower Resistors® are stocked by your distributor.

Note: The horsepower ranges marked on the Plug-in Horsepower Resistors® are not correct for PWM controls - See chart.

The Plug-in Horsepower Resistor® will match the motor characteristics to the control without having to calibrate the Current Limit (CL) and IR Compensation (IR) for most applications.

TABLE 3 - PLUG-IN HORSEPOWER RESISTOR® CHART*

Motor Armature Current (Amps DC)	Plug-in Horsepower Resistor® (OHMS)	90 VDC SCR Rated Motor Horsepower	130 VDC PWM Rated Motor Horsepower
3.3 - 6.0	.1	1/3 - 1/2	1/2
2.5	.18	1/4	1/3
1.3 - 2.0	.25	1/8 - 1/6	1/6 - 1/4
.7 - 1.0	.51	1/15 - 1/10	1/12 - 1/8
.4 - .6	1.0	1/30 - 1/20	1/20 - 1/15
.1 - .3	2.0	1/50 - 1/100	1/30 - 1/50

* (1) For motor current not on chart use next lowest value Plug-in Horsepower Resistor®
(2) Disregard the horsepower ranges marked on Plug-in Horsepower Resistor® since they are not correct for PWM controls. Refer to resistance value in ohms.

Appendix Figure 6

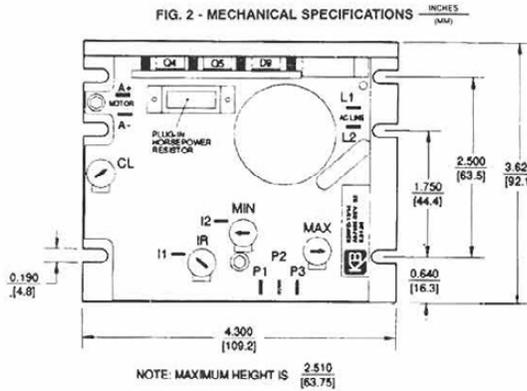
II. INSTALLATION INSTRUCTIONS

A. Location and Mounting

The KBWD control should be mounted on a flat surface and located in an area where it will not be exposed to contaminants such as water, metal chips, solvents or excessive vibration. (See Fig. 2 for Mechanical Specifications.)

When mounting in an enclosure, the air space should be large enough to provide adequate heat dissipation. The maximum allowable ambient temperature at full rating is 45°C/113°F. Consult factory if more information is required.

FIG. 2 - MECHANICAL SPECIFICATIONS



Appendix Figure 7

B. Initial Setup and Wiring.

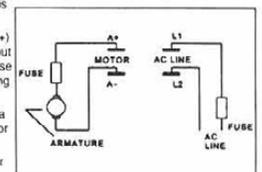
i. General Instructions

1. Install proper size Plug-in Horsepower Resistor®. (See chart - Table 3 p. 4.)
2. Connect the KBWD to a standard 120V 50/60Hz AC line. (Be sure the AC input voltage corresponds to the control voltage rating and the motor rating (e.g. 90 - 130 VDC motor on 120 VAC).)
3. Follow the NEC and other electrical codes that apply.
4. Connect control in accordance to connection diagram - See Fig. 4 p. 7.
5. Ground (earth). The control should be connected to ground (earth) since it contains a metal chassis.
6. When using a step-down transformer (240 VAC to 120 VAC) be sure the VA rating of the transformer is at least 3 times the VA rating of the motor.

ii. Wiring

1. **AC Line** - Connect AC line (120 VAC 50/60 Hz) to terminals L1 and L2. It is recommended that a line fuse or circuit breaker be installed with a 10 amp - 125 VAC rating. Connect chassis to ground (earth).
2. **Motor Armature** - Connect motor armature to terminals A(+) and A(-). Be sure motor voltage corresponds to control output voltage range (90 - 130 VDC). It is recommended that a fuse be installed in series with the armature; choose a fuse rating equal to the motor rating.
3. **Main Potentiometer** - The control can be operated from a remote potentiometer, or from an isolated analog voltage for voltage following.
 - a. **Remote Potentiometer** - Connect remote potentiometer wires to terminals P1, P2 and P3, so that the "high" side of the potentiometer connects P3, the "wiper" to P2 and the "low" side to P1. (See Fig. 5A p. 8)
 - b. **Analog Input** - An isolated 0-5 VDC or analog voltage can also be used to drive the control. Note: If an isolated signal voltage is not available, an optional signal isolator can be installed (Model KBSI-240D, P/N 9431). Connect the isolated input voltage to terminal P2 (positive) and P1 (negative). (See Fig. 5B p. 8)

FIG. 3 - AC LINE AND MOTOR CONNECTION DIAGRAM



Appendix Figure 8

Tradesman DC Variable Speed Bench Grinder --- User's Manual

TABLE 4 - PARTS LIST KBWD-13 (See Table 4a for KBWD-16)

Ckt Ref	Specification	Manufacturer-Type	Description
C2	820µF-250VDC-20%	81DA	Bus Capacitor
C3	100µF-35V-20%	Electrolytic	Capacitor
C4	0.47µF-50V-20%	Electrolytic-NP	Capacitor
C5	0.022µF-50V-20%	Multilayer Ceramic	Capacitor
C6	0.1µF-50V-20%	Multilayer Ceramic	Capacitor
C7,10,12,16,18,19,22,27	1000µF-50V-10%	Multilayer Ceramic	Capacitor
C8 ¹	15µF-35V-20%	Electrolytic	Accel/Decel Capacitor
C9,11,14,24,25	0.01µF-50V-30%	Ceramic Tubular	Capacitor
C13,15,23	100µF-50V-10%	Multilayer Ceramic	Capacitor
C17	0.1µF-50V-20%	Metalized Film	Capacitor
C20	220µF-50V-10%	Multilayer Ceramic	Capacitor
C21	0.01µF-500V-20%	Ceramic Disc	Capacitor
C26	0.01µF-50V-20%	Multilayer Ceramic	Capacitor
D1-8,13	0.15A-100PIV	1N4148	Diode
D9	8A-600PIV	FESF8JT	Fast Diode
ICL1	0.5 - 16A	KCC:CL100	Inrush Current Limiter
IC1	-----	LM358P	Dual Op Amp
IC2	-----	LM339N	Quad Comparator
IC3	-----	TLC555	Timer
PBR1	8A-400PIV	KBUBG	Power Bridge
Q1,3	600mA-40V	2N4403	Bipolar Transistor -
Q2	600mA-40V	2N4401	Bipolar Transistor
Q4	200V-18A	IR.IRF640	Power Mosfet
R1	4.3K-7W/70°C-5%	-----	Resistor
R2,19,22	2.2K-0.25W-5%	Carbon Film	Resistor
R3,20	4.7K-0.25W-5%	Carbon Film	Resistor
R4,8,12,40	47K-0.25W-5%	Carbon Film	Resistor
R5	2.5K-0.15W-20%	Carbon(PT10LV)	MIN Trimpot
R6	10K-0.15W-20%	Carbon (PT10LV)	MAX Trimpot

Appendix Figure 13

TABLE 4 - PARTS LIST KBWD-13 (continued)

Ckt Ref	Specification	Manufacturer-Type	Description
R7	7.5K-0.25W-5%	Carbon Film	Resistor
R8	3.3K-0.25W-5%	Carbon Film	Resistor
R10,18,25,26,30,32,35,A1,A2	10K-0.25W-5%	Carbon Film	Resistor
R11	560K-0.25W-5%	Carbon Film	Resistor
R13	33K-0.25W-5%	Carbon Film	Resistor
R14,16,17	22K-0.25W-5%	Carbon Film	Resistor
R15	100K-0.25W-5%	Carbon Film	Resistor
R23,24	47-0.25W-5%	Carbon Composition	Resistor
R27	330K-0.25W-5%	Carbon Film	Resistor
R28 ¹	5W/70°C-5%	-----	PHR
H29	3.3K-0.25W-5%	Carbon Film	Resistor
R31	1.2K-0.25W-5%	Carbon Film	Resistor
R33	4.7M-0.25W-5%	Carbon Film	Resistor
R34	3.3K-0.25W-5%	Carbon Film	Resistor
R36	10K-0.15W-20%	Carbon (PT10LV)	CL Trimpot
R37	750-0.25W-5%	Carbon Film	Resistor
R38	100K-0.25W-5%	Carbon Film	Resistor
R39	10K-0.15W-20%	Carbon (PT10LV)	IR Trimpot
T1	1:1	-----	Pulse Transformer
Z1	15V-1W-5%	1N4744A	Zener Diode
Z2	7.5V-0.5W-1%	1N5236B	Zener Diode

¹ Component whose value and/or rating may change with application.

TABLE 4a - COMPONENT CHANGES REQUIRED FOR KBWD-16

C2	1500µF-250VDC-20%	81DA	Bus Capacitor
Q5 (to be added)	200V-18A	URF640	Power Mosfet

Appendix Figure 14

V - LIMITED WARRANTY

For a period of 18 months from date of original purchase, KB will repair or replace without charge devices which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. The foregoing is in lieu of any other warranty or guarantee expressed or implied, and we are not responsible for any expense, including installation and removal, inconvenience, or consequential damage, including injury to any person, caused by items of our manufacture or sale. Some states do not allow certain exclusions or limitations found in this warranty so that they may not apply to you. In any event, KB's total liability, under all circumstances, shall not exceed the full purchase price of this unit. (rev 4/88)



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Appendix Figure 15