

## 234-401-031 UPGRADE INSTRUCTIONS

The following instructions are for upgrading the torque signal amplifier board (78D176 and earlier) to the current production version, the TSC 401.

### A. DISASSEMBLY

1. Disconnect all cables and electrical power from the dynamometer to be updated.
2. Remove all screws retaining the back panel to the dynamometer cabinet.
3. Locate the old load cell amplifier board and remove all wires from it.
4. Remove the retaining screws and set the board aside.
5. Locate the 14-pin dynamometer connector and remove all wires from it.
6. Remove the retaining screws and set the connector aside.
7. Locate the four insulated terminal posts on the dynamometer upright that have the small gage load cell wires connected to them.
8. Carefully remove the four heavier gage wires from the posts, while leaving the load cell wires attached.
9. Remove any resistor soldered to these terminals.
10. Locate the speed pickup assembly near the rotating pulse disk.
11. Remove the GREEN, WHITE and BROWN wires from the pickup board.
12. The old wires may now be removed from the dynamometer and discarded. Be careful to leave the brake and load cell wires attached to their respective terminals.

### B. HARDWARE PREPARATION

1. Using the supplied template, locate and drill the hole pattern from the inside of the back panel. The template should be positioned so that the three 'B' holes are offset to the upper right of the pattern and it should be located as close to the 14-pin dynamometer hole as possible without causing interference with any other parts in the cabinet.
2. Install the nylon standoffs in the 'A' holes using the #6 self-tapping screws. The screw heads should be on the outside of the back panel.
3. Insert the small end of the 14-conductor cable assembly (88M071) through the back panel connector opening until the large connector is resting on the outside mounting surface of the panel.

**NOTICE**

It may be necessary to square off the corners of the opening in order for the connector to fit. Do this with a metal file, being careful not to get any chips in the hysteresis brake.

4. Secure the 14-pin connector to the back panel using the 4-40 screws, lock washers and nuts.

**NOTICE**

If ordered as a kit for a specific dynamometer, section C "Board Preparation" is performed at the factory.

## C. BOARD PREPARATION

- Referring to the 234-401-031 circuit board (see page 5 for schematic), make a solder jumper across the solder link marked "SL15". This is located near the CW and ZERO pots on the component side of the board. **Note: steps 2-6 do not apply to -5 dynamometers.**
- Using the following table, select the appropriate resistor value (R19) for the dynamometer that you are updating.

Dynamometer	Full Scale		R19 Resistor	Solder Link to be done	-6		-7		-8		
	Value	Unit			DPA DP9	DPB DP12	DPA DP9	DPB DP12	DPA DP9	DPB DP12	
HD-100	-6	11	oz·in	12.4 K	1 to 8	O	X	O	O	X	O
	-7	800	g·cm	8.66 K							
	-8	80.0	mN·m	8.66 K							
HD-106	-6	2.5	oz·in	5.23 K	1 to 7/8	O	X	X	O	O	X
	-7	180.0	g·cm	54.9 K							
	-8	18.00	mN·m	54.9 K							
HD-400	-6	40	oz·in	4.22 K	1 to 7/8	X	O	O	X	O	O
	-7	2.80	kg·cm	2.87 K							
	-8	280	mN·m	2.87 K							
HD-500	-6	120	oz·in	13.7 K	1 to 6/7	X	O	O	X	O	O
	-7	8.50	kg·cm	9.31 K							
	-8	850	mN·m	9.31 K							
HD-505	-6	240	oz·in	2.49 K	1 to 8	O	O	O	X	O	O
	-7	17.00	kg·cm	20.5 K							
	-8	1700	mN·m	20.5 K							
HD-510	-6	120	oz·in	13.7 K	1 to 6	X	O	O	X	O	O
	-7	8.50	kg·cm	9.31 K							
	-8	850	mN·m	9.31 K							
HD-515	-6	240	oz·in	2.49 K	1 to 8	O	O	O	X	O	O
	-7	17.00	kg·cm	20.5 K							
	-8	1700	mN·m	20.5 K							
HD-700	-6	425	lb·in	4.42 K	1 to 7	O	O	X	O	O	X
		440	lb·in	4.64 K							
	-7	30	kg·cm	3.09 K							
		31.0	kg·cm	3.24 K							
	-8	3.0	N·m	3.09 K							
		3.10	N·m	3.24 K							
HD-705	-6	50	lb·in	5.23 K	1 to 6/7	X	O	X	O	O	X
		55	lb·in	5.76 K							
	-7	60.0	kg·cm	6.49 K							
		62.0	kg·cm	6.65 K							
	-8	6.0	N·m	6.49 K							
		6.20	N·m	6.65 K							
HD-710	-6	480	lb·in	5.11 K	1 to 6	O	O	X	O	O	X
		440	lb·in	4.64 K							
	-7	32.5	kg·cm	3.40 K							
		31.0	kg·cm	3.24 K							
	-8	3.3	N·m	3.40 K							
		3.10	N·m	3.24 K							
HD-715	-6	55	lb·in	5.76 k	1 to 6	X	O	X	O	O	X
	-7	65.0	kg·cm	6.98 k							
		62.0	kg·cm	6.65 k							
	-8	6.5	N·m	6.98 k							
		6.20	N·m	6.65 k							

Dynamometer		Full Scale		R19 Resistor	Solder Link to be done	-6		-7		-8	
		Value	Unit			DPA DP9	DPB DP12	DPA DP9	DPB DP12	DPA DP9	DPB DP12
HD-800	-6	100	lb·in	11 K	1 to 7	X	O	X	O	O	X
		125	lb·in	14 K							
	120	kg·cm	13.7 K								
	140.0	kg·cm	16.2 K								
	-8	12.00	N·m	13.7 K							
		14.00	N·m	16.2 K							
HD-805	-6	200	lb·in	2 K	1 to 7/8	O	O	O	O	X	O
		250	lb·in	2.55 K							
	240	kg·cm	2.43 K								
	280	kg·cm	2.87 K								
	-8	24	N·m	2.43 K							
		28.0	N·m	2.87 K							
HD-810	-6	125	lb·in	14 K	1 to 6	X	O	X	O	O	X
	-7	140.0	kg·cm	16.2 K							
	-8	14.0	N·m	16.2 K							
HD-815	-6	250	lb·in	2.55 K	1 to 6	O	O	O	O	X	O
	-7	280	kg·cm	2.87 K							
	-8	28.0	N·m	2.87 K							
HD-825	-6	500	lb·in	5.23 K	1 to 8	O	O	O	O	X	O
	-7	560	kg·cm	5.90 K							
	-8	56.5	N·m	5.90 K							

Solder this resistor in the designated location on the circuit board. The resistor must be a 1%, 50 ppm metal film type or better.

3. Make a solder jumper across the solder link marked "SL16". This is located near one end of R19 that was installed in the previous step.
4. Set the gain of the first stage by making solder jumpers across the appropriate links (SL1 – SL11) for the dynamometer being updated. The table above lists the links to jumper based on dynamometer model.
5. Make a solder jumper across the appropriate decimal point link (DP9 or DP12) based on the listing in the following table.

DP9	DP12	Decimal Point Display
O	O	XXXX.
X	O	XXX.X
O	X	XX.XX
X	X	X.XXX

O = Open ; X = Done

The links are located between the two headers to the side of the gain links (SL1–SL11).

6. Move the slide switch labeled "SW1" to the 60-bit position.

## D. BOARD INSTALLATION

1. Snap the 234-401-031 board onto the standoffs making certain that the pot adjustment screws align with the 'B' holes.
2. Strip and tin the three wires of the cable assembly 88M076 and solder to the speed pickup as follows:

Green	Common
White	F <sub>0</sub>
Brown	+5

3. Remove approximately 1.5 inches of gray sheathing from the four conductor cable assembly, 88M075. This is a shielded, two-twisted pair cable. Remove the bare drain wire and foil shield. Carefully separate each twisted pair from the other. You should have a twisted Black-Red pair and a twisted Black-White pair. The Black-Red pair carries  $\pm 5$  V excitation to the load cell. The Black-White pair carries the load cell signal to the amplifier board.
4. Strip and tin the Black-Red pair, the Black-White pair, and connect to the insulated terminals on the upright as follows:

Black	Small gage White
Red	Small gage Red
Black	Small gage Green
White	Small gage Blue

5. Connect the 14-pin receptacle to the board header and press in firmly. This is a polarized and locking connector; it can only go in one way.
6. Connect the 3-pin receptacle to the board header labeled "60-bit". Note that the board header on the 234-401-031 is 5-pin. The 3-pin receptacle should be plugged into the center (pins 2, 3, 4). Pins 1 and 5 will not be connected.
7. Connect the 5-pin receptacle to the board header labeled "LOAD CELL" in the proper orientation.
8. Perform a visual check of your work, looking for shorts, unplugged connectors, or interference with other objects on the back panel or upright.

## E. CALIBRATION

1. Place the CW CAL - ZERO - CCW CAL sticker over the holes in the back panel.
2. Center the CW CAL - ZERO - CCW CAL pots by rotating the adjusting screws at least 25 turns in the clockwise direction, then back 10 turns in the counter-clockwise direction.
3. Connect the dynamometer cables to the appropriate readout and power supply, or controller.
4. Apply AC power to all equipment.
5. Attach the calibration beam to the dynamometer shaft.
6. Apply full current to the dynamometer brake by turning the Torque or Current control fully clockwise.
7. Level the calibration beam.
8. Note the torque reading.
9. Temporarily attach a 100 K resistor from the White load cell wire to the Green load cell wire.
10. Note the direction of change in torque reading.
11. If the reading moves away from zero, remove the end from the Green wire and attach it to the Blue wire. The reading should now move closer to zero.
12. Install a resistor decade box, or a variable resistance of 1M Ohm, in place of the resistor from the previous step.
13. Adjust the value of resistance until the torque reading is near zero.
14. Obtain a 1%, 50 ppm metal film resistor of similar value and solder it onto the 234-401-031 board using the open holes identified "R20".
15. Solder the jumper "Blu" or "Grn" on the circuit board depending on which was determined to give the lowest reading from steps E.9 through E.11. These are located on either side of the "LOAD CELL" connector.
16. Adjust the dynamometer ZERO trim pot so that the torque reading is zero  $\pm 1$  least significant digit.
17. Hang a calibrated weight of sufficient size from the clockwise pin on the calibration beam. The weight times distance calculation should be equal to, or near, the full scale rating of the dynamometer.

18. Level the calibration beam.
19. Adjust the CW CAL trim pot so that the torque reading equals the weight times distance. If the reading cannot be brought into calibration by turning the trim pot between either of its extremes, add or remove solder links from SL1 –SL11 until calibration occurs near the center of the trim pot travel.
20. Transfer the weight to the counter-clockwise pin of the calibration beam.
21. Level the calibration beam.
22. Adjust the CCW CAL trim pot so that the torque reading equals the weight times distance.
23. Re-install the back panel and secure with the screws set aside in step A.2.
24. Repeat steps E.17 through E.22 to check your adjustments.
25. Remove the weight from the beam.
26. Turn the Torque or Current counter-clockwise while pumping the calibration beam CW/CCW. This will ensure that there are no residual bumps left on the rotor.
27. Remove the calibration beam.

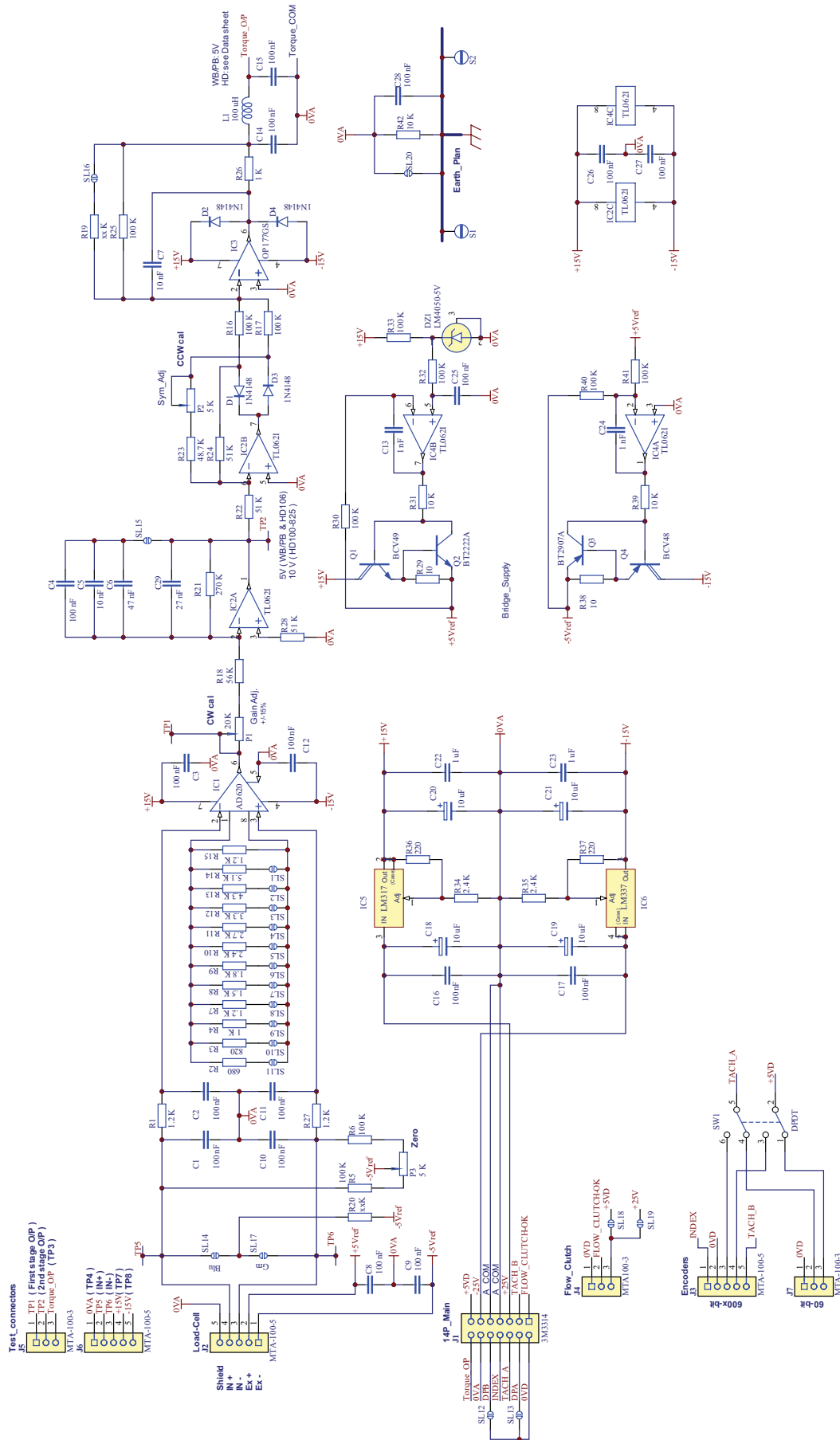
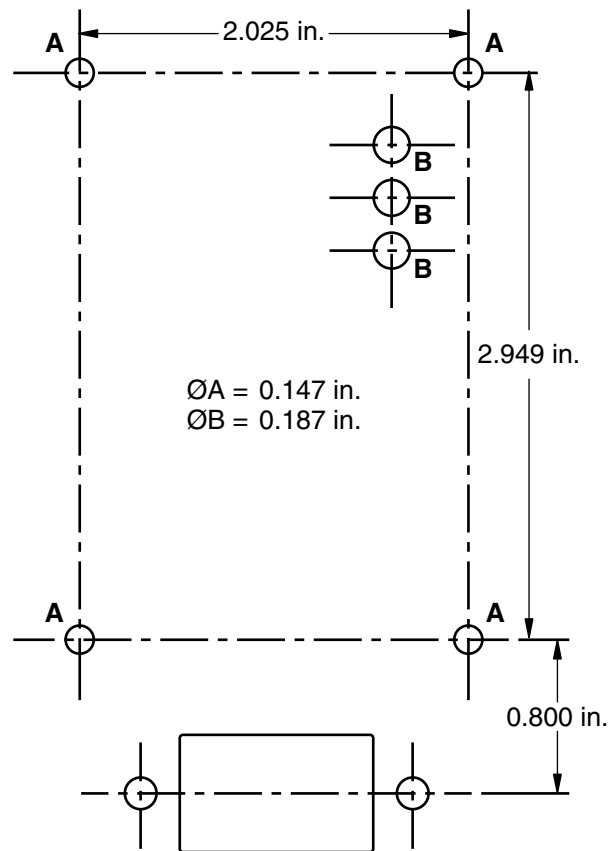
**FIGURE 1. TSC 401 TORQUE AMPLIFIER (234-401-031 CIRCUIT BOARD)**


FIGURE 2. TEMPLATE


**NOTICE**

When printing from Adobe Acrobat Reader version 5.0 and above, in order to ensure that the template is the correct size, be sure to DESELECT the "Shrink oversized pages to paper size" check box under the Print options. In Acrobat Reader version 4.0 and earlier, DESELECT the "Fit to page" option.

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### MAGTROL INC

70 Gardenville Parkway  
Buffalo, NY 14224 | USA  
phone +1 716 668 55 55  
fax +1 716 668 87 05  
e-mail [magtrol@magtrol.com](mailto:magtrol@magtrol.com)

### MAGTROL SA

Rte de Montena 77  
1728 Rossens | Switzerland  
phone +41 26 407 30 00  
fax +41 26 407 30 01  
e-mail [magtrol@magtrol.ch](mailto:magtrol@magtrol.ch)

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