

# Model 721+ Mechanical Power Instrument

## Use With a mV/V Strain Gage Sensor and a Frequency Output Sensor



Superb instrument for mV/V torque, force, and pressure sensors, and frequency producing speed, flow and velocity transducers

- **reads, displays, processes and outputs**
  - **shaft torque, speed, power**
  - **pump/motor head, flow, fluid power**
  - **drawbar force, velocity, power**
- **fast, rock solid readings with high noise immunity**
  - **7,800 samples/sec. for torque, head or drawbar force input**
  - **1 millisecond response for speed, flow or velocity input**
- **6 full digit engineering unit display with user defined legends**
- **RS232, RS422 or RS485 serial communication**
- **auto-scaled, selectable Voltage or Current analog outputs**
- **Cross channel calculation performed at 7,800 Hz**

These advanced instruments provide engineering unit display of a strain gage (mV/V) input and a frequency input. They also compute power and perform 21 functions including limit checks, tare, hold, and max/min capture. You needn't write code or add hardware to be up-and-running a productive test.

The alphanumeric readout can display measured and computed data, units of measure and test status. During setup, it guides you with English language prompts. There are no manual adjustments. To calibrate, enter the full scale value in engineering units and auto-cal provides 0.001% display resolution and analog voltage or current outputs (user selectable). The keyboard accesses measured data, held data, max/min data, data spread, limit status, and/or I/O status without test disruption. Password protection may be used, if needed.

The mV/V conditioner has the advantages of ac carriers with the operating simplicity of dc. Microprocessors provide true ac null balance without manual adjustments. Frequency is processed with a proprietary algorithm that achieves both

fast response and 0.01% resolution at any full scale. With a bi-directional (quadrature) input, it outputs both signal magnitude and direction; only magnitude data is output for uni-directional inputs. Excitation and power are furnished for both sensors; no need for external power. The Model 721+ is easy to use, has high sensitivity with superior noise immunity, and is unaffected by thermal and galvanic voltages. Use it with directly wired or transformer coupled mV/V sensors and low or high level frequency producing devices.

Select either RS232, RS422 or RS485 communications to remotely acquire data, and setup and control instrument modes. User configurable logic I/O's can be linked to input actions and output events. When used in its State Mode, Event Driven Tests can be done - without special hardware or software - see AN7000 for details. Included software remotely controls all Instrument functions from a Windows-based PC. The same software displays, plots and saves real time data, does X-Y plots, and will save and download the Instruments' setup parameters.

# S. HIMMELSTEIN AND COMPANY

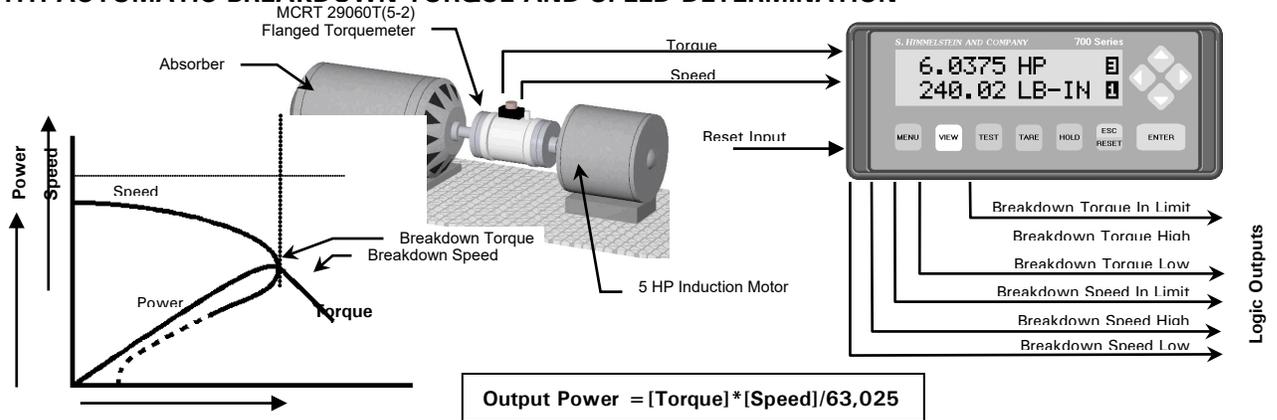
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## Model 721 + Specification

<b>Strain Gage Input</b> .....	Any 80 $\Omega$ to 2k $\Omega$ transducer, directly wired or transformer coupled. 4, 6, or 7 wire circuits are accommodated.
<b>Transducer Excitation</b> .....	3Vrms, 3030Hz $\pm$ 0.01% sine wave. Regulated, and short circuit protected.
<b>Sensitivity</b> .....	0.5 to 5mV/V with 150% overrange; automatically scaled.
<b>Input Impedance</b> .....	100M $\Omega$ in parallel with 33pF.
<b>Automatic Null</b> .....	In Phase: $\pm$ 10% of F.S. (with 150% overrange), $\pm$ 60% of F.S. (with no overrange). Quadrature: $\pm$ 1mV/V.
<b>Auto Calibration</b> .....	Dual polarity shunt calibration with provision for CAL resistor feedback.
<b>Spurious Signal Rejection</b> .....	60Hz: 120dB common mode, 100dB normal mode. Carrier quadrature: 60dB.
<b>Antialias Filter</b> .....	7 pole Bessel response filter.
<b>Low Pass Filtering</b> .....	4 pole Bessel response digital filter with 11 cutoff frequencies from 0.1 to 200Hz in 1-2-5 steps.
<b>Signal-to-Noise Ratio</b> <sup>1</sup> .....	with 1/10/100/200Hz filters 86/76/66/62dB @ 1mV/V F.S. and 86/80/72/66dB @ 5mV/V F.S.
<b>Resolution</b> .....	0.001% of F.S.
<b>Overall Accuracy (at 77°F/25°C)</b> .....	0.02% of F.S., worst case.
<b>Temperature Effects</b> .....	Zero: $\pm$ 0.001% of F.S./°F (max); Span: $\pm$ 0.001% of F.S./°F (max).
<b>Frequency Input</b> ...	Any uni-directional or bi-directional (quadrature) source including self generating and zero velocity magnetic pickups, optical encoders, flowmeters, etc. When used with bi-directional sensors, the conditioner outputs both <u>direction</u> and <u>magnitude</u> .
<b>Input Impedance and Configuration</b> .....	Differential or single ended inputs. 100k $\Omega$ differential, 50k $\Omega$ single ended.
<b>Input Threshold</b> (keypad selectable) .....	10, 20, 50, 100, or 200mVpk-pk (between inputs) or TTL.
<b>Maximum Voltage</b> .....	$\pm$ 130VDC or 130Vrms.
<b>Input Signal Bandwidth</b> .....	0.001 to 200kHz (10 to 200mV pk-pk threshold), 0.001 to 400kHz (TTL threshold).
<b>Display Ranges and Resolution</b> .....	Rangeless (use any F.S. Engineering Unit value) with 150% overrange. Resolution is 0.01% of F.S.
<b>Low Pass Filter</b> (keypad selectable) .....	20kHz (-3dB) or none. This filter is not available for TTL inputs.
<b>Response Time</b> .....	Greater of: 1 ms, typical (2 ms worst case) or the input pulse length.
<b>Common Mode Rejection</b> .....	80dB (60Hz), 55dB (0 to 10kHz).
<b>Low Pass Filtering of Sampled Data</b> .....	Unfiltered or 4 pole Bessel filter. Cutoff frequencies from 0.1 to 100 Hz in 1-2-5 steps.
<b>Overall Accuracy</b> .....	0.01% of F.S. @ +77°F (+25°C), 0.015% of F.S. @ +41°F to +122°F (+5°C to +50°C).
<b>Excitation Supplies</b> .....	+12V@125mA <sup>2</sup> or +5V@250mA <sup>2</sup> , short circuit (current limit) and overvoltage (fuses) protected.
<b>Maximum Transducer Cable Length</b> .....	500ft except 200ft for 100 $\Omega$ or lower strain gage transducers.
<b>System Display</b> .....	2 line by 16 alphanumeric characters, each 0.2" wide by 0.3" high. Backlit LCD with adjustable contrast.
<b>Views</b> .....	Select either 2 Channels, 1 Channel with Limit Status, or 1 Channel with I/O Status.
<b>Data Displayed</b> .....	Select from Current, Max, Min, Spread, Held data and Tare value.
<b>Data Format</b> .....	Engineering units with 6 digits (1-2-5 format) and 5 character, upper or lower case, user-entered legend/descriptor.
<b>System Response (per channel)</b>	
<b>Data Sampling &amp; Max/Min Update Rates</b> .....	7,800Hz (hardware channels and CH3 calculation).
<b>Limit Checking Rate</b> .....	2,600Hz (hardware channels and CH3 calculation).
<b>Logic I/O Response Time</b> .....	384 $\mu$ s (hardware channels and CH3 calculation).
<b>Update Rate for Each Analog Output</b> .....	2,600Hz.
<b>System Control</b> .....	All I/O functions can be OR'd in any combination. The <i>pattern</i> function adds AND'ing capabilities.
<b>Input Actions/Channel</b> .....	Logic inputs, outputs, and internal Matrix signals control following actions. Tare, Clear Tare, Hold, Clear Hold, Reset Max/Min, Clear Latched Limits, Check Limits, Do Max/Mins, Apply +CAL, Apply -CAL.
<b>Output Events/Channel</b> .....	The following events drive Logic outputs and internal Matrix signals. HI Limit, NOT HI Limit, IN Limit, NOT IN Limit, LO Limit, NOT LO Limit, At Max, NOT At Max, At Min, NOT At Min.
<b>Eight User-defined Patterns</b> .....	Patterns of Logic inputs, outputs and Matrix signals drive Logic outputs and internal Matrix signals.
<b>State Machine Capability</b> ..	User enabled/disabled. Permits up to eight states and allows Event Driven Testing. See AN7000 for details.
<b>Limit Checking</b> .....	Each channel has a HI and LO limit which may be latched or unlatched, absolute or signed, and with or without hysteresis. Select either Current, Max, Min, Spread or Held data for limit checking. Limit violations on any or all channels can be set to trigger backlight flashing in any of the display view modes.
<b>Four Logic Inputs</b> .....	Each with programmable destination, protected to $\pm$ 48V.
<b>Type</b> .....	TTL compatible, low-true with 2k $\Omega$ pull-up. Input current is -1.5mA @ 0V.
<b>Six Logic Outputs</b> .....	Each with programmable source, short circuit (current and thermal limits) and overvoltage protected.
<b>Type</b> .....	Open collector, low-true. Operating @ 24V (max) and 0.3A max sink current.
<b>External +5VDC Power</b> (on I/O connector) .....	250mA, short circuit (current limit) and overvoltage (fuse) protected.
<b>Serial Communication Port</b> (selectable as RS232, RS422, or RS485. Supports 32 devices on RS485 port and 1 device on RS232/422)	
<b>BAUD Rate</b> .....	1.2 to 230.4 kBaud. Maximum Cable Length: 4000ft (RS422/RS485), 50ft (RS232).
<b>120<math>\Omega</math> Termination Resistors</b> (RS485) .....	User selectable for RXD and TXD.
<b>RS422/485 Transceivers</b> .....	Slew-rate limited, short circuit protected (current & thermal limits).
<b>RS232 Drivers</b> .....	Short circuit protected (current limit).
<b>Serial I/O's</b> .....	Use a 9 pin D connector. They are $\pm$ 15kV ESD protected and float (100k $\Omega$ ) with respect to Earth Ground.
<b>Commands</b> .....	Control of all modes, settings, and measurements.
<b>Non-Volatile Memory Storage for System Settings</b> .....	EEPROM, batteries are not used.
<b>Dual Analog Outputs</b> .....	Each assignable to any of the 3 channels are short circuit (current limit) and overvoltage (fuse) protected.
<b>Output Impedance/Minimum Load Resistance</b> .....	< 1 $\Omega$ /10k $\Omega$ .
<b>Full Scale</b> .....	Selectable from 0 to $\pm$ 10V (maximum) or 0 to 20 mA. Resolution is 0.5mV or 0.5 $\mu$ A.
<b>Overrange</b> .....	Voltage overrange is 150% of Full Scale (F.S.) or $\pm$ 15V Max., Current overrange is 150% of F.S. or 23.2 mA.
<b>Non-linearity</b> .....	$\pm$ 1mV or $\pm$ 1 $\mu$ A.
<b>Protection</b> .....	Short circuit (current limit) and overvoltage protected to $\pm$ 32V.
<b>Size and Weight</b> .....	6.5" wide, 2.9" high, 8.7" deep. Weight is 3 pounds.
<b>Operating Temperature</b> .....	+41°F to +122°F (+5°C to +50°C).
<b>Input Power</b> .....	90VAC to 250VAC, 50/60Hz @ 25VA, max. Two 2A/250V fuses, line filter, and rear power switch.

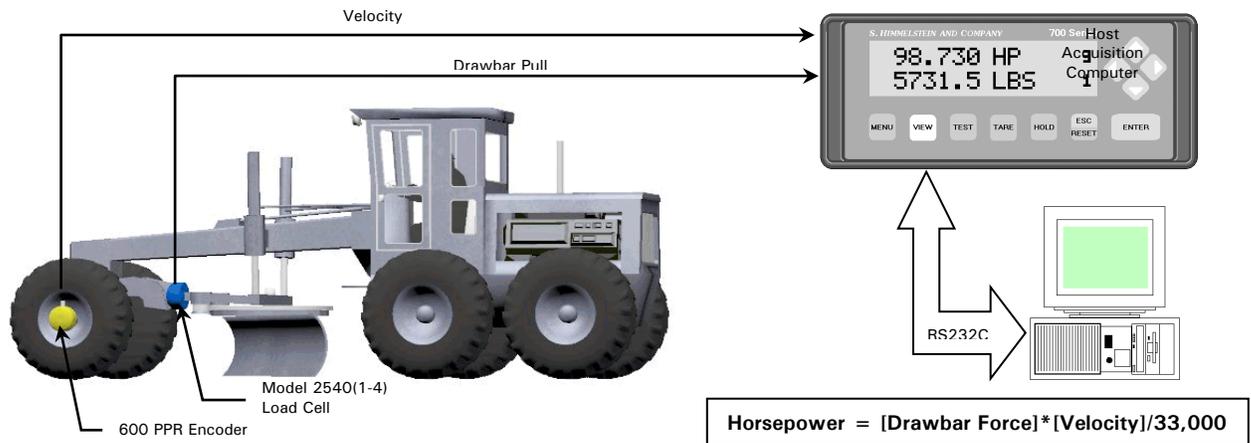
- Notes:
1. The ratio expressed in decibels (dB), of Full Scale (F.S.) to noise spread. Measurements are made for a 1 minute interval using a 350 $\Omega$  bridge.
  2. Both excitation voltages can be used simultaneously with the following restrictions: 4.8 x (12V current) + (5V current)  $\leq$  700mA  
AND 12V current  $\leq$  125mA AND 5V current  $\leq$  250mA.
  3. Specification is subject to change without notice.

# ELECTRIC MOTOR TORQUE, SPEED AND OUTPUT HORSEPOWER TESTER WITH AUTOMATIC BREAKDOWN TORQUE AND SPEED DETERMINATION



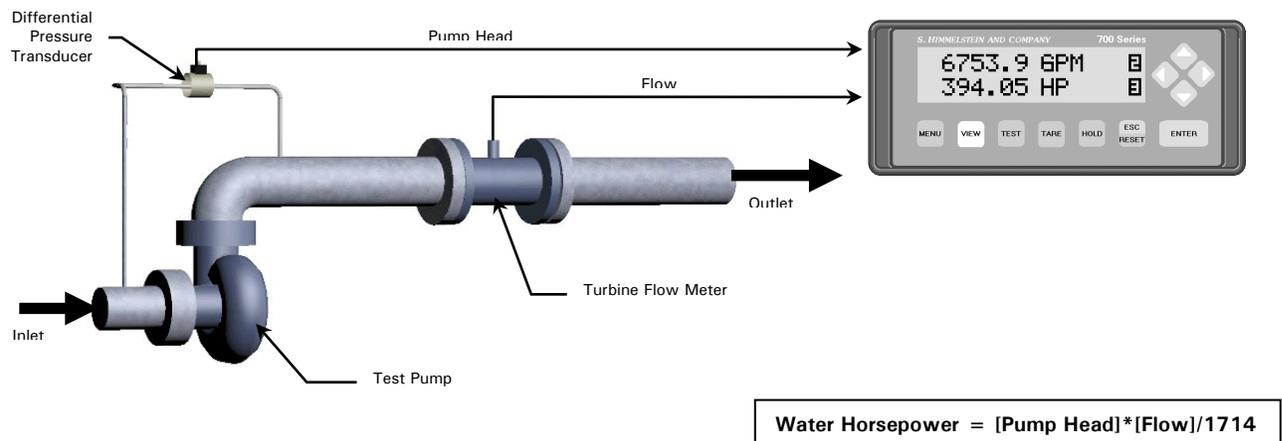
The Model 721 + instrument is set to display current data; TORQUE (CH 1) or SPEED (CH 2) and SHAFT POWER (CH 3). The motor is loaded above the BREAKDOWN TORQUE and the instrument automatically captures and holds BREAKDOWN TORQUE, SPEED and SHAFT POWER. Held breakdown values can be displayed, classified in or out of limits and may be downloaded to a computer. Next, the load is brought to specified points and TORQUE, SPEED and SHAFT POWER are read from the display and/or downloaded to the attached computer. Before testing the next motor, the Model 721 + is Reset from the front panel or, via its I/O.

## DRAWBAR FORCE, VELOCITY AND POWER MEASUREMENT



The Model 2540 Universal Load Cell is installed in the drawbar linkage and measures DRAWBAR FORCE (CH 1) in pounds. A 600 PPR encoder, installed on the non-driven axle, measures VELOCITY (CH 2) scaled in feet/minute (FPM). POWER (CH 3) is computed per above. Current and MAX/MIN data are available as well as analog and digital data outputs.

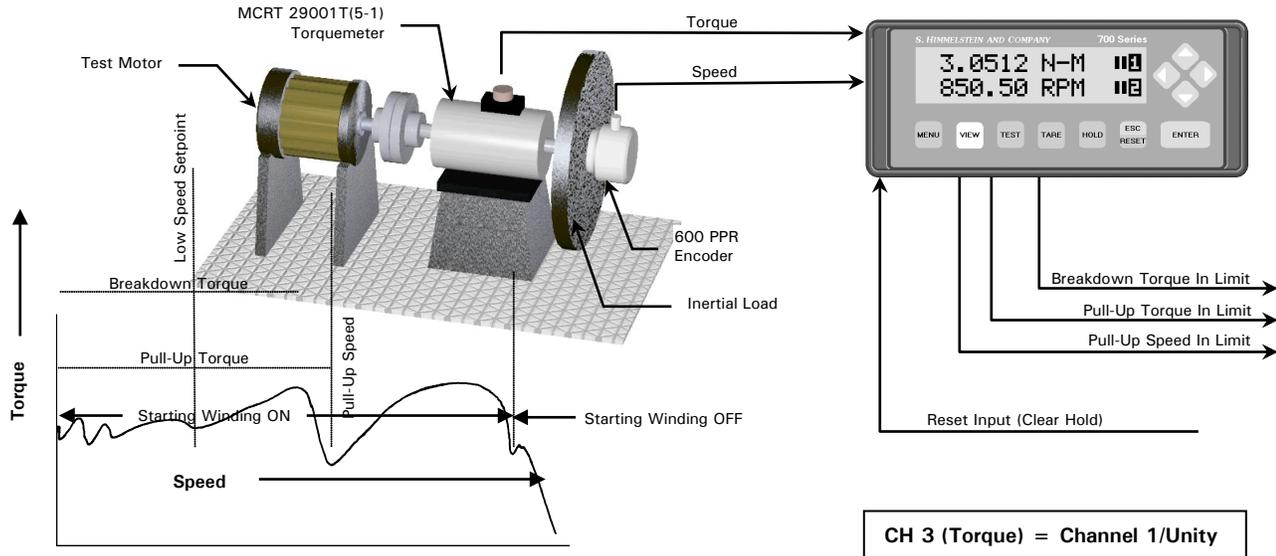
## PUMP HEAD, FLOW AND WATER POWER MEASUREMENT



The Model 721 + displays PUMP HEAD (CH 1) in PSI, and/or FLOW (CH2) in GPM, and WATER HORSEPOWER (CH 3). Any of the three channels can be displayed by using front panel switches. Current and MAX/MIN data may be recalled for any or all channels and limits may be set on each channel. The limits can be downloaded from a host computer and test data can be uploaded to that computer.

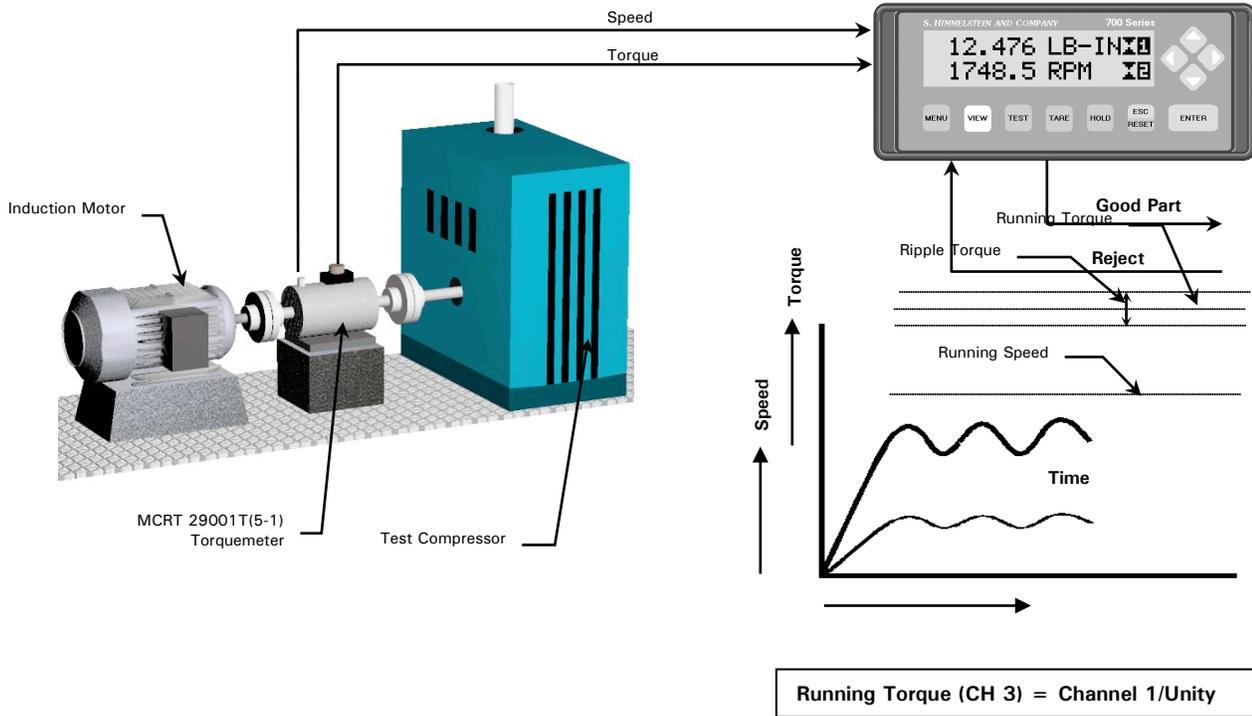
**Overview:** The Model 721 + 's superb signal conditioners and its extensive library of powerful data processing, calculation, logical, I/O and communication functions allow it to handle a wide variety of unique production and data acquisition tasks. Two are illustrated. Many more are possible. Call anytime to discuss your needs with an experienced Applications Engineer.

### BREAKDOWN TORQUE + PULL-UP TORQUE AND SPEED MEASUREMENT



The test motor drives an Inertia Load fitted with a 600 PPR speed sensor. At test start, the Model 721 + displays current data. When CH2 (SPEED) low limit signals speed is above the start windings' low end variations, the Do Max/Min function is automatically invoked for CH1 (TORQUE). Thereafter, when CH1 detects a Maxima, Channel 1 is *held* capturing BREAKDOWN TORQUE. When CH3 reaches the PULL-UP TORQUE, both CH3 and CH2 (PULL-UP SPEED) are *held*. All three held values can be displayed and are automatically classified. The 721 + ignores winding switching torques and the near zero torque condition at the end of the run.

### COMPRESSOR RIPPLE TORQUE, RUNNING TORQUE AND SPEED TESTER



The Model 721 + checks the single phase motor and compressor combination to verify torque ripple, and running torque and speed are acceptable. Excessive ripple leads to noise and vibration and reduces life. Running torque/speed checks verify efficiency. The instrument measures TORQUE (CH 1 and CH 3) and SPEED (CH 2). After reaching minimum acceptable running speed (detected by CH 2 low limit), Channel 1 is automatically switched to its Do Max/Min mode. Then, Channel 1 limits classify its spread or TORQUE RIPPLE. When the assembly is at final speed, CH 2 limits classify the RUNNING SPEED, and CH 3 limits classify RUNNING TORQUE. The display is set to read RIPPLE TORQUE (CH 1) or RUNNING TORQUE (CH 3) and RUNNING SPEED (CH 2). A GOOD/BAD signal is also