

## 3194 MOTOR/HARMONIC HiTESTER

Power Measuring Instrument



**3194**  
High order harmonic  
analysis function  
Harmonic analysis up to the  
3000th order

**9603-01**  
External  
Signal Input  
Unit



### Inverter Motor Analysis Station!

Ideal for analyzing high-  
order harmonics produced by  
equipment such as household  
appliances

connects directly to  
a strain gauge  
torque sensor



Up to 6 input channels for analysis of inverter motors  
and high-order harmonics!

## All the functions you need for motor evaluation and harmonic analysis!

### Harmonic analysis to the 3000th order



3194 MOTOR/HARMONIC HiTESTER provides analysis of high-order harmonics up to the 3000th order. This makes it ideal for analyzing and evaluating the performance of inverter motors and for harmonic analysis of household appliances. Additionally, with the optional 9603-01 EXTERNAL SIGNAL INPUT UNIT installed, the HiTESTER can directly measure torque and rotation speed, an essential feature for evaluating the performance of inverter motors. This makes it easy to construct measurement systems.



ISO 9001  
JMI-0216



ISO 14001  
JQA-E-90091



The Right Source For Your Test & Measurement Needs

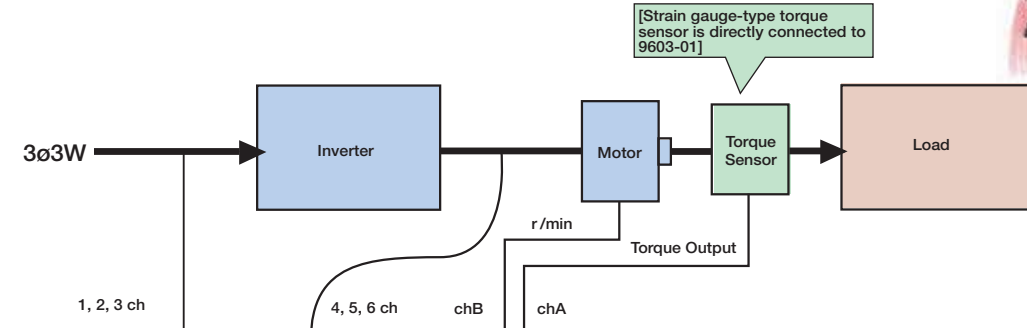
2232 Verus Street Suite D San Diego CA 92154 USA  
Toll Free: 866.363.6634 Tel: 619.429.4545 Fax: 619.374.7012  
Email: sales@calright.com <http://www.calright.com>

Comprehensive measurement of power, rotation speed, torque, converter efficiency, and harmonics, all with a single unit

# Analysis Station Extends Reach of Motor Evaluation!

## ■ 3194 Performs Comprehensive Evaluation of 3-phase Inverter Motors

Using the 9603-01 EXTERNAL SIGNAL INPUT UNIT a torque sensor (strain gauge) is directly connected to chA. By inputting the output of a tachometer (analog signal or pulse signal) to chB, a system for measuring torque, rpm and motor power can be obtained.



1, 2, 3 ch  
Primary V/A/W/PF, Harmonic analysis

4, 5, 6 ch  
Secondary V/A/W/PF and motor output measurement  
Efficiency (primary to secondary, secondary to motor output and primary to motor output)  
Secondary harmonic analysis

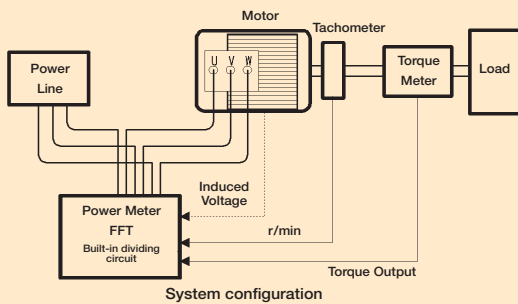
### ■ With direct or clamp input unit, capable of measuring from micro motors up to large-size motors

Supports measurements of everything from micro motors used for household appliances and OA equipment up to industrial large-size motors. Also supports various applications such as harmonic measurement of equipment power sources and power quality measurement.



## ■ Application: Measuring the electrical angle of synchronous motors

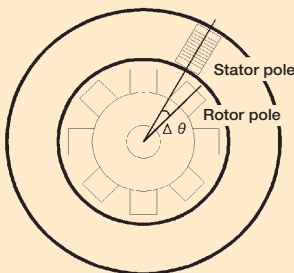
- FFT analysis synchronized with a motor synchronization signal (rotation pulse from a tachometer, motor induced voltage)



- Phase shifts of the fundamental wave on the secondary side of the inverter can be measured with respect to the synchronization signal  
The angular displacement between the magnetic poles of a motor's stator and its rotor caused by changes in load torque can be measured as a change in electrical angle. (Measurement is performed by taking the no-load phase angle as zero.)
- Built-in dividing circuit (division up to 1/255), also supports multi-pulse signals  
Note: This type of measurement can be used with synchronous motors that rotate synchronously with voltage frequencies. It cannot be used with sliding induction motors. Please consult us if insulation is necessary, such as with induced voltages.

### Harmonic vector display

The phase angle and electrical angle ( $\Delta\theta$ ) between voltage and current of the fundamental voltage and electrical angle can be displayed as vectors. This makes it easy to grasp the relationships between phases.



Variation in electrical angle ( $\Delta\theta$ ) between the magnetic poles of the motor's stator and its rotor

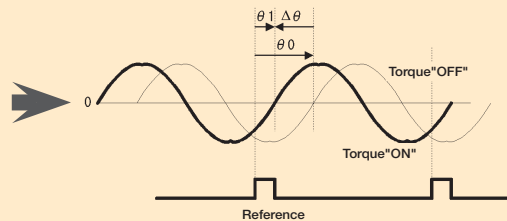


Figure demonstrating the principle of electrical angle ( $\Delta\theta$ ) measurement



## Harmonic Waveform Analysis Functions

### ■ Features

Capable of measuring carrier frequencies on the secondary side of inverters. Also allows analysis to be synchronized with motor rotation.

**Measurement lines** : Single-phase 2- and 3- wire, three-phase 3- and 4-wire  
**No. of channels** : Up to 3 channels from channels 1 to 6, depending on 3194 wiring mode  
**Output functions** : Floppy disk, RS-232C/GP-IB, printer  
**Measurement range** : Fundamental frequency: 10 Hz to 4.5 kHz

### ● Harmonic Waveform Analysis Functions

**Measurement method** : PLL or external clock  
**A/D resolution** : 12 bits  
**Windowing type** : Rectangular tiling (with gap between windows)  
**Crest factor** : Up to 2.5 (voltage, current)  
**PLL source** : U, I or external synchronization of the selected measurement channel  
**External synchronization signal** : Input to a rear panel control terminal on the 3194 main unit  
 Input level: 1V to 10 Vrms (for sine waves)  
 Division function: 1/1 to 1/255  
**Measurement items** : RMS voltage, RMS current, effective power value, frequency,  $\pm U_{peak}$ ,  $\pm I_{peak}$   
**Harmonic wave measurement items** : Harmonic level, percentage and phase angle of harmonic wave, Total harmonic distortion (THD-F, THD-R)  
**Screen displays** : List, graph, vector and waveform displays  
**Functions** :  
**Wiring conversion** :  $\Delta$ -Y voltage conversion, Y- $\Delta$  voltage conversion  
**Sort function** : Sorts according to decreasing order of analysis, displays up to 50th order  
**Averaging function** : Index average with time constant of 1.5 sec

### Frequency ranges:

	Fundamental Frequency	Sampling speed (Hz)	Window Width	Analysis Order
PLL Synchronization Ranges	10 - 17.5 Hz	$f \times 8192$	1 waveform	3000 ( 10kHz or less)
	17.5 - 35 Hz	$f \times 8192$	1 waveform	3000 ( 10kHz or less)
	35 - 70 Hz	$f \times 8192$	1 waveform	3000 (100kHz or less)
	70 - 140 Hz	$f \times 4096$	2 waveforms	1500 (100kHz or less)
	140 - 280 Hz	$f \times 2048$	4 waveforms	800 (100kHz or less)
	280 - 560 Hz	$f \times 1024$	8 waveforms	400 (100kHz or less)
	560 - 1120 Hz	$f \times 512$	16 waveforms	200 (100kHz or less)
Fixed clock	----	50 $\times$ 8192 Fixed	2 waveforms	3000 (100kHz or less)

Note 1: Analysis order accuracy is restricted to the frequency in brackets.  
 Note 2: With PLL synchronization in the range of 10 to 35 Hz, an anti-aliasing filter of about 15 kHz is used, and with PLL synchronization in the range of 35 Hz to 4.5kHz, an anti-aliasing filter of about 120 kHz is used.

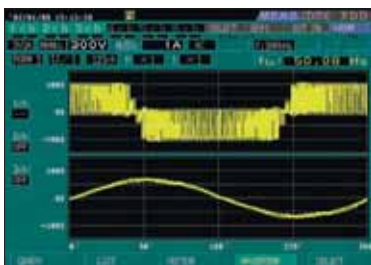
### Graph Display of Harmonics

The secondary fundamental components and the carrier component level of the inverter can be observed at a glance.



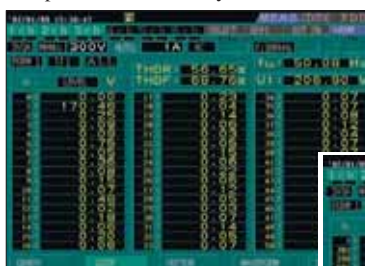
### Waveform Display

Voltage and current waveforms are displayed. Simultaneous 3 channel display of RMS and peak values along with voltage and current waveforms is possible. [Simultaneous 3-channel display applies only in the case of 2-phase 3-wire (3-voltage 3-current) and 3-phase 4-wire.]



### List Display of Harmonics

Voltage, current and power are analyzed and amplitude, component ratios, and phase angle are shown numerically. Up to 50 harmonic levels are displayed in order of decreasing size by the sort function. Sections having large harmonic components can be easily determined.



Sort display in order of maximum value

## 9603-01 EXTERNAL INPUT UNIT SPECIFICATIONS (Optional)

### ■ Features

Torque, rotation speed, and motor power can be measured by inputting analog torque and rpm signals to the 9603-01 EXTERNAL INPUT UNIT. Further, an input terminal is provided for use with a strain gauge-type torque sensor.

- Direct connection to a strain gauge-type torque sensor is possible. (No external amplifier is necessary)
- The strain gauge input terminal has a sense function, and is not easily affected by changes in sensor cable length.
- Zero correction function is provided for strain gauge input.

**Number of input channels** : 2 channels  
**ChA** : Strain gauge sensor or DC voltage input (BNC)  
**ChB** : Pulse or DC voltage input (BNC) (dedicated connector)  
**Strain gauge input specifications**  
**Applicable converter** : Strain gauge type converter (bridge resistance 350 - 1.5k  $\Omega$ )  
**Measurement range** : 1 mV/V / 1.5 mV/V / 2 mV/V  
**Measurement accuracy** :  $\pm 0.1\%$ rdg,  $\pm 0.065\%$ f.s.  
**Connector** : PRC03-23A10-7F (manufactured by Tajimi) (chA/chB common BNC connector)  
**DC voltage input specifications**  
**Input resistance** : 200k  $\pm 5\%$  (differential)  
**Measurement range** :  $\pm 1.0000 / \pm 5.0000 / \pm 10.000V$   
**Maximum operating input range** :  $\pm 20V$   
**Measurement accuracy** :  $\pm 0.1\%$ rdg,  $\pm 0.1\%$ f.s. (23°C  $\pm 5^\circ C$ , not higher than 80%rh)  
**Pulse input specifications** : (chB, BNC connector)  
**Frequency measurement** : 1Hz - 100 kHz (measurement accuracy depends on the frequency measurement accuracy of the main unit)  
**Maximum operating input range** :  $\pm 20V$   
**Common specifications**  
**Temperature coefficient** :  $\pm 0.03\%$ f.s./  $^\circ C$   
**Analog output** :  $\pm 5V$  f.s., Output accuracy and measurement accuracy  $\pm 0.2\%$ f.s.

**Configuration example**

**Wiring diagram**

■ Outline of Option Specifications

■ Input Unit Specifications

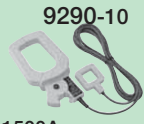
	9600 AC/DC DIRECT INPUT UNIT			9601 AC DIRECT INPUT UNIT		
	Voltage	Current	Power	Voltage	Current	Power
Measurement range	6.0000/15.000/30.000/ 60.000/150.00/300.00/ 600.00V/1.0000kV	200.00/500.00mA/ 1.0000/2.0000/5.0000/ 10.000/20.000/50.000A	Depends on combination of voltage and current ranges	60.000/150.00/300.00/ 600.00V/1.0000kV	200.00/500.00mA/ 1.0000/2.0000/5.0000/ 10.000/20.000/50.000A	Depends on combination of voltage and current ranges
Max operating input (55Hz)	1000Vrms/1500V peak	65Arms/100Apeak		600Vrms/850V peak	65Arms/100Apeak	


9602 CLAMP INPUT UNIT			
	Voltage	Current	Power
Measurement range	6.0000/15.000/30.000/60.000/150.00/300.00/600.00V	500.00mA to 500.00A (Depends on clamp-on sensor)	Depends on combination of voltage and current ranges
Max operating input (55Hz)	600Vrms/850V peak	Depends on clamp-on sensor	

**AC Clamp-on Sensor**


**9290-10**  
1500A,  
φ 55mm,  
Width 80mm,  
bus-bar,  
20 Hz to 5 kHz,  
CT ratio 10:1



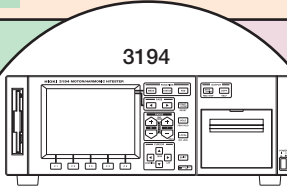
**9270** 20A,  
φ 20mm,  
5 Hz to 50 kHz




**9271** 200A,  
φ 20mm,  
5 Hz to 50 kHz




**3194**



**+ 9602**




**9272** 20A/200A,  
φ 46mm, 50 φ  
20mm bus-bar,  
5 Hz to 10 kHz




**AC/DC Clamp-on Sensor**


20A / 200A,  
φ 20mm,  
DC to 100 kHz



500A,  
φ 40mm,  
DC to 20 kHz



500A,  
φ 36mm,  
DC to 100 kHz

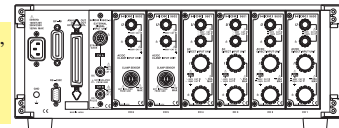


New

**Ordering Information**

**3194 MOTOR/HARMONIC HiTESTER**(main unit only)

Measurements cannot be taken with a 3194 MOTOR/HARMONIC HiTESTER unit only. A factory option unit, 9600 ~ 9604, 9603-01 must be purchased. In the event of unit replacement or extension, the work involved is done at the factory, and unit cost + service fee are charged. Selection should be made with care from the measurement line table below.



	1ch	2ch	3ch	4ch	5ch	6ch
<b>Pattern A</b>	1φ2W ( )	1φ2W ( )	1φ2W ( )	1φ2W ( )	1φ2W ( )	1φ2W ( )
<b>Pattern B</b>	1φ3W / 3φ3W ( ×2)		1φ2W ( )	1φ2W ( )	1φ2W ( )	1φ2W ( )
<b>Pattern C</b>	1φ3W / 3φ3W ( ×2)		1φ3W / 3φ3W ( ×2)		1φ2W ( )	1φ2W ( )
<b>Pattern D</b>	1φ3W / 3φ3W ( ×2)		1φ3W / 3φ3W ( ×2)		1φ3W / 3φ3W ( ×2)	
<b>Pattern E</b>		3φ3W (3V3A) / 3φ4W ( ×3)		1φ2W ( )	1φ2W ( )	1φ2W ( )
<b>Pattern F</b>		3φ3W (3V3A) / 3φ4W ( ×3)		1φ3W / 3φ3W ( ×2)		1φ2W ( )
<b>Pattern G</b>		3φ3W (3V3A) / 3φ4W ( ×3)		3φ3W (3V3A) / 3φ4W ( ×3)		

( ) : 9600, 9601, 9602 can be selected.

**Notes on input unit selection**

- Use the same input unit for a particular measurement line.
- Units are installed in sequence starting from channel 1. If there is a blank, the blank is filled with a blank panel for shipment.
- For the 9603-01 and 9604, only one unit can be installed.
- When the 9602 is selected, use one of the optional clamp on sensors.

■ Options (factory-installation only)

(Specify at time of order)

9600	AC/DC DIRECT INPUT UNIT
9601	AC DIRECT INPUT UNIT
9602	AC/DC CLAMP INPUT UNIT *
9603-01	EXTERNAL SIGNAL INPUT UNIT
9604	PRINTER UNIT

\* The voltage cable is not supplied.  
Contact your dealer when it is necessary to use the clip type leads.

■ Options

** 9270	CLAMP ON SENSOR (AC 20A)
** 9271	CLAMP ON SENSOR (AC 200A)
** 9272	CLAMP ON SENSOR (AC 20/200A)
9277	UNIVERSAL CLAMP ON CT (AC/DC 20A)
9278	UNIVERSAL CLAMP ON CT (AC/DC 200A)
** 9279	UNIVERSAL CLAMP ON CT (AC/DC 500A)
9709	AC/DC CURRENT SENSOR (AC/DC 500A)
9290-10	CLAMP ON ADAPTER (AC 1500A 10:1)
9232	RECORDING PAPER (10m, 10 rolls, For 9604)

\*\* No CE marking

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