

## CLARKE - HESS MODEL 6000

# PHASE METER

EASY TO CALIBRATE  
EASY TO USE



- Waveform Independent
- 10mV to 350V Input Voltages
- 10.000:1 Input Ratios
- Completely Autoranging
- 10 m° Resolution
- 20 m° Typical Accuracy
- 5 Hz to 500 kHz
- Analog Output
- Low Drift with Time and Temperature

### USER FRIENDLY

The Model 6000 Phase Meter automatically selects the proper range for both amplitude and phase and is wave shape independent. The user only needs to connect the two input cables to obtain a phase reading. Overrange and Underrange LED's indicate whether either of the two input signals is too large or too small. An OFFSET toggle on the front panel allows the user to make differential phase measurements without the need of subtracting large numbers. No front panel screwdriver adjustments for any function are required.

### IEEE-488 INTERFACE STANDARD

The Model 6000 Phase Meter has an optically isolated IEEE-488 1978 interface as a standard feature. Via the Bus interface the user can read the display, toggle the phase range, and check for input signal overrange or underrange, front panel selected offset and phase range. The optical isolation prevents ground loops (and the resulting phase errors) between the input signals and the digital bus controller circuits.

### TWO PHASE RANGES - EXCELLENT TRACKING

The Model 6000 Phase Meter has two phase ranges: The 0° to 360° range and the ±180° range. Range switching occurs either automatically when the display indication approaches within 10° of the range limit or manually when the front panel RANGE toggle switch is pressed. In the regions where the ranges overlap, differences of less than ±10m° result when switching occurs.

### NOISE IMMUNITY

Unique circuitry, including filter banks which switch in automatically as the input frequency is decreased and unipolar hysteresis around the comparators, enables the Model 6000 Phase Meter to operate to low frequencies with input signals which have been corrupted by noise or other disturbances without erratic operation. Keyboard control allows removal of the filters for optimum square wave measurements. Display indicates whether filters are "in" or "out" of the circuit.

### WIDE FREQUENCY RANGE

The Model 6000 Phase Meter operates with input frequencies between 5Hz and 500kHz. For frequencies between 10Hz and 50kHz typical accuracies are ±20m° regardless of amplitude ratios which may exceed 10000:1.

### WAVE SHAPE INDEPENDENT

The accuracy of the Model 6000 Phase Meter is maintained not only for sine waves but also for square waves and triangular waves. Unique internal circuitry produces waveform independent phase readings; hence, the user does not have to activate any front panel waveform selection switches. Two different waveforms of the same frequency may be applied to the Phase Meter simultaneously.

### AUTOMATED CALIBRATION

The inclusion of the IEEE Bus allows both the USE and the CALIBRATION checking of the Model 6000 to be easily automated.



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### HIGH ACCURACY/LOW DRIFT

Typical accuracy of  $\pm 20\text{m}^\circ$  and low drift are obtained by complete circuit integration under microprocessor control. Potential drifts due to voltage variations are eliminated by differential dual slope analog to digital converters. Effects of analog offsets are eliminated with the use of dual comparators in each channel.

### HIGH INPUT RATIOS.

Accuracies of  $\pm 50\text{m}^\circ$  (typically  $\pm 20\text{m}^\circ$ ) are maintained not only with equal amplitude signals in both channels but also with amplitude ratios in excess of 1000:1 (60db) between the signals.

### ROBUST INPUT PROTECTION

Unique input protection circuitry allows for the sudden application of high input voltages without fear of damage to the Model 6000 Phase Meter. There is no need to slowly increase the levels of input voltages.

### FLOATING INPUTS

Neither input of the Model 6000 Phase Meter is connected to chassis ground; hence measurements may be made on networks with "earth ground" connections without creating ground loops with their resultant phase errors.

### FAST SETTLING TIME

The Model 6000 Phase Meter settles to within its specified accuracy typically within 5 seconds following an abrupt change in input conditions.

### EVEN HARMONIC REDUCTION

The Model 6000 Phase Meter has been designed to reduce phase errors caused by the presence of even harmonic distortion present in one input channel and not the other. For example, a 1% second harmonic distortion component in one channel produces a phase error of less than  $5\text{m}^\circ$  which is less than the minimum phase resolution of the Phase Meter.

## SPECIFICATIONS

### MODEL 6000 DIGITAL PHASE METER

#### PHASE

**Ranges:** Two Ranges  $0^\circ$  to  $360^\circ$  and  $-180^\circ$  to  $180^\circ$ . Range switching is accomplished automatically when operation approaches within  $10^\circ$  of the range limits.

**Resolution:**  $10\text{m}^\circ$  (0.01 $^\circ$ )

**Repeatability:**  $\pm 10\text{m}^\circ$  or better

**Accuracy:**  $\pm 200\text{m}^\circ$  from 5Hz to 10Hz  
(Sine Waves)  $\pm 50\text{m}^\circ$  from 10Hz to 50kHz  
 $\pm [50 + 2(\text{fkHz} - 50)]\text{m}^\circ$  from 50kHz to 100kHz  
 $\pm [150 + 3.5(\text{fkHz} - 100)]\text{m}^\circ$  from 100kHz to 500kHz  
(Square Waves)  $\pm [50 + (\text{fkHz})]\text{m}^\circ$  (Equal Amplitudes)  
 $\pm [50 + 4.4(\text{fkHz})]\text{m}^\circ$  (Unequal Amplitudes at Range Limits)

**Offset:** The OFFSET toggle subtracts the current phase reading from all subsequent phase readings. The range about the Offset point is  $\pm 180^\circ$  which is independent of phase autoranging.

#### INPUT CHARACTERISTICS-EITHER CHANNEL

**Amplitude Range:** 10mV RMS to 350V RMS in three ranges: 10mV to 500mV RMS, 500mV to 12.5V RMS and 12.5V to 350V RMS. Range switching is accomplished automatically when operation approaches within approximately 10% of the range limits. (From 10mV to 20mV derate phase accuracy by a factor of 2.)

**Input Impedance:** 1MW in parallel with less than 50pF. Front Panel BNC.

**Input Waveforms:** Sine, Triangle, Trapezoidal or Square. The Phase Meter provides a reading proportional to the average of the difference between the positive zero crossings and the difference between the negative zero crossings of the inputs. These zero crossings are determined after the waveforms are AC coupled.

**Maximum dc Input:** The dc component of either input waveform should be 200V or less.

**Frequency Range:** 5Hz to 500kHz

**RESPONSE TIME:** Less than 6 seconds for specified

accuracy.

**DISPLAY:** 0.5" High Efficiency LED Display for Phase. Small High Efficiency LED Lamps to indicate Phase Range, REMOTE, Phase OFFSET ON, and OVERRANGE and UNDERANGE for both input channels.

#### CONTROLS

**Front Panel:** Phase OFFSET key switch, LOCAL key switch and Phase RANGE toggle key switch.

**Rear Panel:** Five position IEEE-488 Address switch.

#### ANALOG OUTPUT

+1.80 to -3.60V DC with a sensitivity of -10mV/ $^\circ$  and an accuracy of  $\pm 0.5\%$  + phase accuracy. 250ohm output impedance. Rear Panel BNC .

#### IEEE-488 SUBSETS

SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0

#### WARMUP TIME

Less than 30 minutes for all specifications.

#### TEMPERATURE RANGE

Specified Accuracy:  $23^\circ\text{C} \pm 5^\circ\text{C}$   
Safe Operation:  $0^\circ\text{C}$  to  $50^\circ\text{C}$

#### RELATIVE HUMIDITY

Specified Accuracy: 20% to 75% RH  
Safe Operation: 5% to 90% RH

#### LINE VOLTAGE, FREQUENCY AND POWER CONSUMPTION

100V  $\pm 10\%$ , 120V  $\pm 10\%$ , 220V  $\pm 10\%$ , 240V  $\pm 10\%$  (Rear Panel switch selectable), 50Hz - 60Hz  
Power Consumption less than 20W

#### PHYSICAL

Rack or bench mount. Bail allows  $10^\circ$  upward tilt.  
Weight: 5.1kg (11 pounds)  
Size: 48.3cm x 8.9cm x 33.0cm (19" x 3.5" x 13")