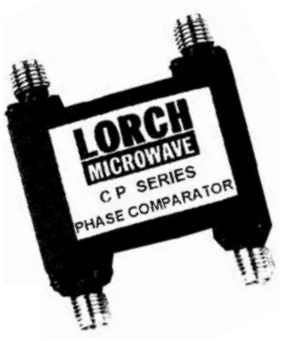
Phase Comparators



- **0.2-750 MHz Frequency Range**
- **Up to 33% Bandwidth**
- **Wide dynamic range**
- **High phase stability**
- **High accuracy**
- **PC mount and connectorized**

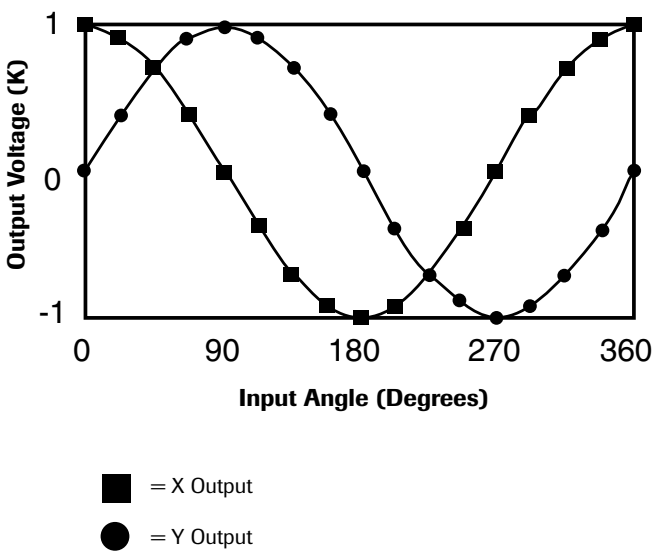
Lorch Microwave's CP-Series, Phase Comparators, are broad band devices which accept two input signals of the same frequency, providing two video outputs, proportional to the sine and cosine of the input phase difference. These outputs can be used to form an unambiguous 360 degree visual phase indication by observation of a moving dot on an oscilloscope.

The angular position of the dot is a measure of the angular difference between the inputs. Arithmetical division of the sine and cosine outputs gives the tangent of the angular difference. This technique is particularly useful for providing extended linear range for phase discrimination in phase-locked loop circuits.

Applications

- **Measurement of insertion phase of networks or transmission lines**
- **Phase detection in phase-locked loops**
- **Resolution of complex signals for presentation in polar form**
- **AGC sensing in phase-lock receivers**
- **Phase demodulation for group delay measurements**
- **Comparison of received phase difference between antenna outputs in direction finding systems**

FIGURE 1
INPUT PHASE ANGLE vs OUTPUT VOLTAGE



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LORCH MICROWAVE

Phase Comparators

Lorch Microwave's CP-Series, Phase Comparators, consists of interconnected mixers, quadrature hybrid, power divider and diplexers. These components are especially designed for low intermodulation distortion and VSWR characteristics. Figure 2 shows the basic schematic for a Phase Comparator.

Definition of Terms

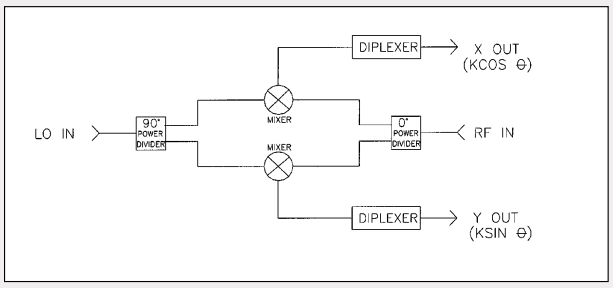
Phase Error
The DC output voltages, X and Y, are proportional to the cos(Ø) and sin(Ø) respectively. To obtain the value Ø, output voltages X and Y are measured and Ø is computed from:
Measured Ø = $\tan^{-1}$ (Y/X). The phase error is thus defined as: Phase Error = Actual Ø-$\tan^{-1}$ (Y/X).

Peak Phase Error
The phase error of a given comparator has peak values which occur at a few phase difference points. These are stable and repeatable and can be reduced by system calibration.

Zero Crossing Error
The indicated phase difference when the actual input phase difference is exactly 0 degrees.

DC Offset Voltage
The DC video output voltage across 50 Ohms occurring with only the reference input (Port LO) energized.

FIGURE 2
SCHEMATIC, PHASE COMPARATOR



Low-Level Comparators

Lorch Microwave's CP-13 Series, Low-Level Phase Comparators, are designed to accept RF input signal levels of up to +3 dBm.

General Electrical Specifications

LO/RF Characteristics
LO/RF Center Frequency, Fo: 0.2-500 MHz
Bandwidth: Fo ±5%
LO Input Level: +13 ±2 dBm
RF Input Level: +3 dBm max.
Nominal Impedance: 50 Ohms
VSWR: 1.4:1 typ. (1.6:1 max.)

X/Y Video Ouput Characteristics
"X" Output: k Cos Ø
"Y" Output: k Sin Ø
Bandwidth: DC-10% RF
Peak Amplitude: 85 mV min. into 50 Ohms, for 0 dBm input at Port RF
Nominal Impedance: 50 Ohms
X/Y Amplitude Balance: ±5 mV max.
Conversion Loss: 11 dB max.
DC Offset Voltage: ±2 mV typ.

PHASE ACCURACY

Center Frequency (MHz)	Phase Error @ Fo (Deg)	Phase Error @ Fo ± 5% (Deg)	Zero Crossing @ Fo (Deg)
0.2 - 10	± 1.0	± 3.0	± 1.0
10 - 100	± 1.5	± 3.5	± 1.0
100 - 200	± 1.7	± 4.0	± 1.5
200 - 300	± 2.0	± 4.5	± 1.5
300 - 400	± 2.5	± 5.0	± 1.7
400 - 500	± 2.5	± 5.0	± 2.0

Notes:

Standard units are designed to provide optimum performance over the full 10% bandwidth. If the band of interest is narrower, it should be indicated when ordering (See "Creating a Part Number"). Performance will be optimized over the band of interest and improved performance may be offered at no extra cost.

High-Level Comparators

Lorch Microwave's CP-20 Series, High-Level Phase Comparators, are designed to accept RF input signal levels of up to +10 dBm.

General Electrical Specifications

LO/RF Characteristics

LO/RF Center Frequency, Fo: 0.2-500 MHz
Bandwidth: Fo ±5%
LO Input Level: +20 ±2 dBm
RF Input Level: +10 dBm max.
Nominal Impedance: 50 Ohms
VSWR: 1.4:1 typ. (1.6:1 max.)

X/Y Video Ouput Characteristics

"X" Output: k Cos Ø
"Y" Output: k Sin Ø
Bandwidth: DC-10% RF
Peak Amplitude: 190 mV min. into 50 Ohms, for +7 dBm input at Port RF
Nominal Impedance: 50 Ohms
X/Y Amplitude Balance: ±5 mV max.
Conversion Loss: 11 dB max.
DC Offset Voltage: ±5 mV typ.

PHASE ACCURACY

Center Frequency (MHz)	Phase Error @ Fo (Deg)	Phase Error @ Fo ± 5% (Deg)	Zero Crossing @ Fo (Deg)
0.2 - 10	± 1.0	± 3.0	± 1.0
10 - 100	± 1.5	± 3.5	± 1.0
100 - 200	± 1.7	± 4.0	± 1.5
200 - 300	± 2.0	± 4.5	± 1.5
300 - 400	± 2.5	± 5.0	± 1.7
400 - 500	± 2.5	± 5.0	± 2.0

Notes:

Standard units are designed to provide optimum performance over the full 10% bandwidth. If the band of interest is narrower, it should be indicated when ordering (See "Creating a Part Number"). Performance will be optimized over the band of interest and improved performance may be offered at no extra cost.

Part Number Description

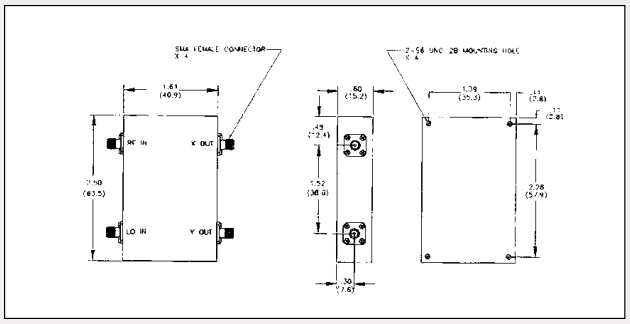
CP - 13 - 200 - 20 - S - 75
1 2 3 4 5 6

1 **CP** Series, Phase Comparator
2 **13** Reference LO-Level
3 **200** Center Frequency in MHz
4 **20** Bandwidth in MHz
5 **S** Package Style, S-SMA, P-PC Mount
6 **75** Impedance, if other than 50 Ohms

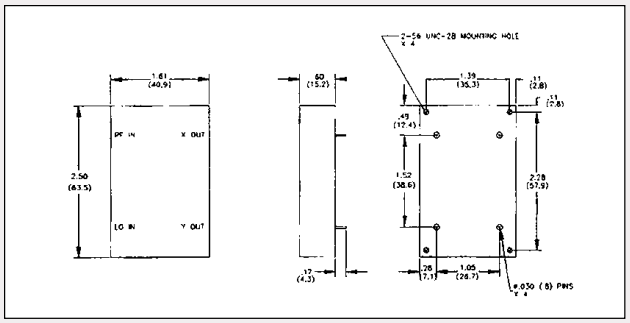
Creating a Part Number

Lorch Microwave's CP-Series, Phase Comparators, have descriptive part numbers indicating the important electrical characteristics that define the units. A list of "standard" Phase Comparators is given in the preceding sections. For custom designs, please contact the factory.

Outline, Phase Comparator, SMA Connectorized



Outline, Phase Comparator, PC Mount



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