# NF123-204A1 Series
## Exciter/Demodulator

## SPECIFICATIONS

**Exciter Frequency:** 100 to 2500 Hz

**Exciter Amplitude:** 2 to 11 V p-p

**Exciter Stability:**
≤ 250 ppm amplitude/°C

**Demodulator Output:**
to ±10 VDC nominal, 5KΩ min. load

**Demodulator Ripple:**
< 40 mV p-p at carrier frequency

**Demodulator Linearity:**
≤ ±0.2% at 1.2 kHz

**Demodulator Stability:**
±250 ppm gain/°C ±0.1 mV/°C

**Demodulator Gain:**
1 to 6 VDC/V p-p typical, varies with transducer characteristics.

**Demodulator Polarity:**
Output at terminal 11 is negative when voltage at terminal 5 is in phase with voltage at terminal 13.

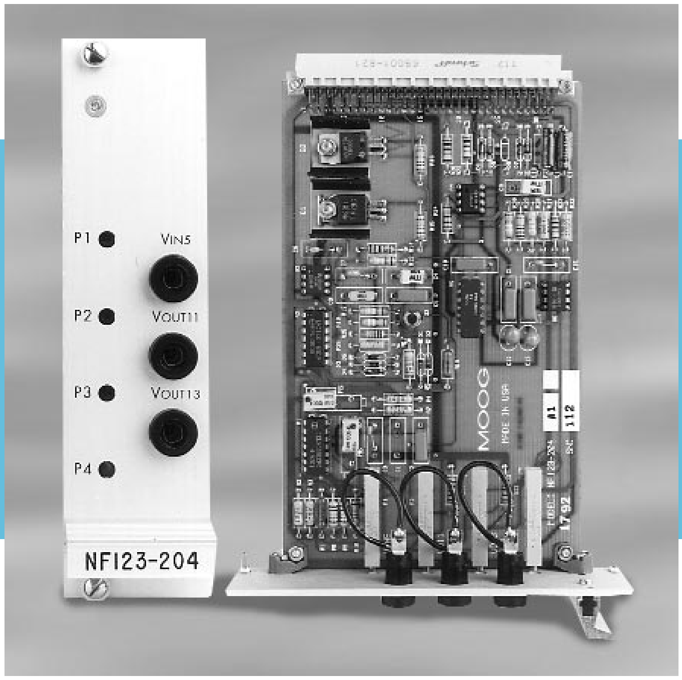
**Frequency Response:**
Phase lag of demodulator output increases linearity from 0° to 180° as frequency of modulation increases from zero to exciter frequency.

**Temperature Range:**
10°C to 50°C (50˚F to 120˚F)

**Connector:** DIN 41612 style C

**Form Factor:**
Eurocard 100 X 160 mm, 7 HP, 3 U

**Weight:** 0.38 lb (0.17 kg)




The NF123-204 Exciter/Demodulator circuit card is designed for use with linear variable differential transformers (LVDT's) in high-performance closed-loop servosystems. The card contains both circuitry to excite an LVDT and circuitry to demodulate the output of the LVDT to a usable form. The output of the card is a DC voltage that is proportional to the displacement of the core of the LVDT.

The NF123-204A1 Exciter/Demodulator is a forward compatible replacement for the F123-204-A001.

## FEATURES

**Exciter**
Adjustable frequency and amplitude for compatibility with a wide range of off-the-shelf LVDT's.

**Demodulator**
Demodulator uses digital sample-and-hold for improved accuracy and frequency response over analog methods.
Adjustable gain (span) allows use of convenient scale factors.

**Output Amplifier**
Adjustable bias (zero) for fast calibration of transducer null.

**Front-Panel Adjustments**
Allow easy access to frequency, amplitude, gain, and bias potentiometers.

**Front-Panel Test Points**
Provide for fast setup, test, and monitoring of LVDT parameters (primary & secondary voltages and demodulated signal).

## ADJUSTMENTS

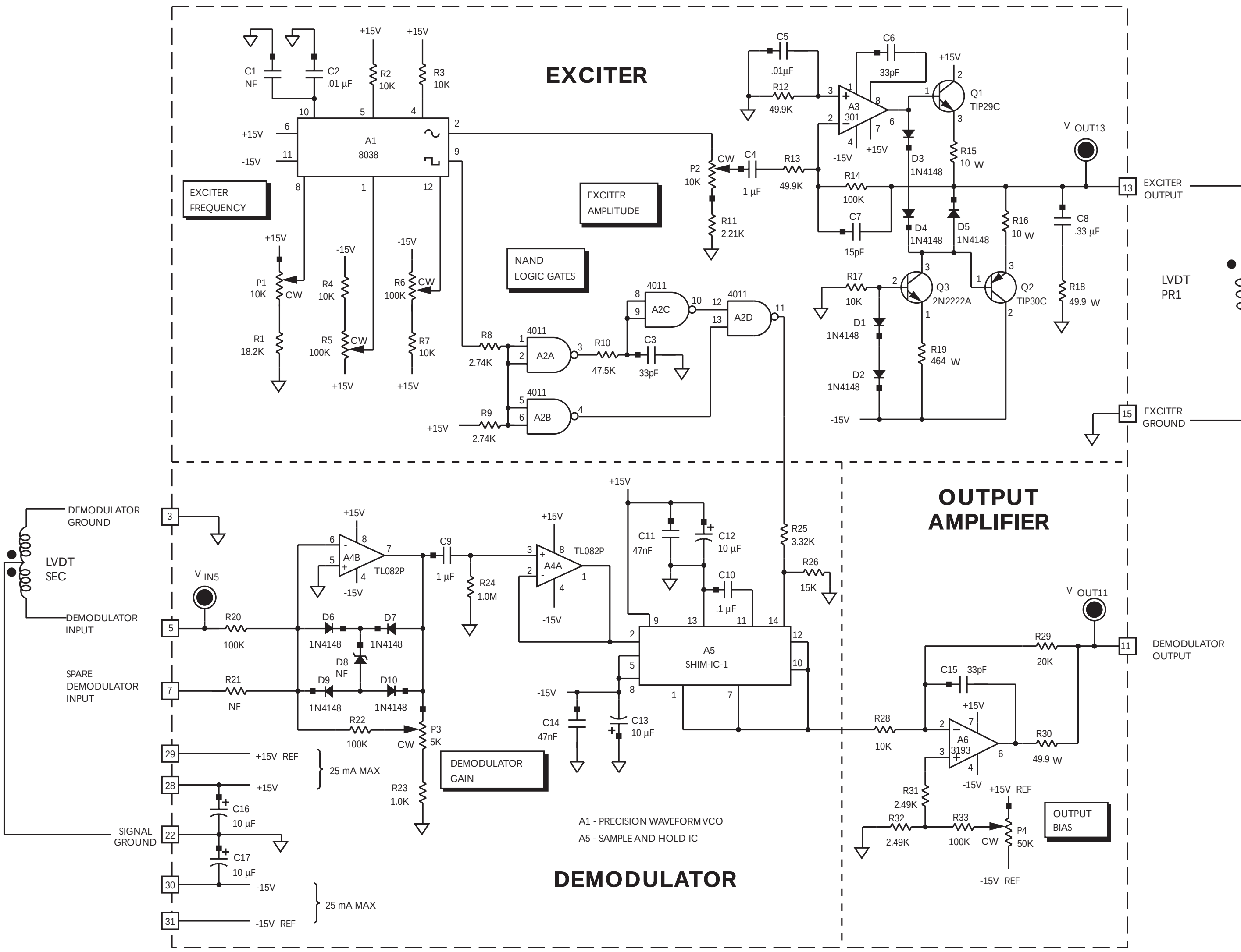
**P1 Exciter Frequency:** Changes frequency of excitation voltage at terminal 13. Turn CW to increase frequency. Adjust for desired excitation frequency.

**P2 Exciter Amplitude:** Changes amplitude of excitation voltage at terminal 13. Turn CW to increase amplitude. Adjust for desired excitation amplitude.

**P3 Demodulator Output Gain:** Changes span of DC output at terminal 11. Turn CW to increase gain. Adjust for desired scale factor (volts/inch).

**P4 Demodulator Output Bias:** Changes offset of DC output at terminal 11. Turn CW to shift output in the negative direction. Adjust for zero VDC at desired transducer position.

## NF123-204A1 EXCITER/DEMODULATOR SCHEMATIC




***An 'Extender Card' is highly recommended to gain access to 'Test Points' and 'Adjustments' while cards are powered-up within a Eurocard Rack Assembly.***

***(Moog ref P/N A81750-1)***

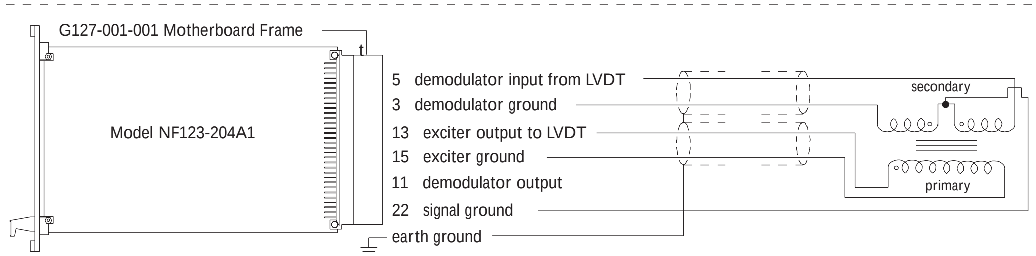
**NOTES:**

1. NF – NOT FURNISHED
2. ■ – PIN 1 (SQUARE PAD ON PCB)
3. CW – CLOCKWISE

## TYPICAL APPLICATIONS

AC-AC LVDT's:

standard linear variable differential transformers, typically used for position feedback from hydraulic cylinders or valve spools.




The products described here are subject to change at any time without notice, including, but not limited to, product features, specifications, and designs.

## TEST SET-UP INSTRUCTIONS

1. Verify ±15VDC at Pin 28 & Pin 30. All voltage measurements are with respect to Pin-22 (PC Board Signal GND).
2. Oscillator Frequency varies with C1, C2 & P1.
3. Ensure proper oscillator frequency is selected & configured on card.
4. Connect Ch1 of Scope to Test Point 'Vout-13' (Pin 13) & monitor voltage waveform.
5. Adjust potentiometer R5 & R6 for Sinewave at Test Point 'Vout-13' (Pin 13). Verify Waveform Symmetry as required. Note: Pots are factory set & should only be adjusted if waveform symmetry is not observed.
6. Adjust EXCITER FREQUENCY pot (P1) for desired Excitation Frequency.
7. Adjust EXCITER AMPLITUDE pot (P2) for approximately 3 to 4 Vp-p at Test Point 'Vout-13' (Exciter Output Pin-13). Ensure saturation is not occurring as indicated by upper & lower flat waveform sections.
8. Connect Ch1 of Scope to Test Point "Vin" (A5-Pin2) and Ch2 to Test Point "Sample" (A5-Pin 14).
9. Observe Sample Pulse occurring at Sinewave 'peak' (LVDT offset from Zero). Refer to attached waveform diagrams.
10. The sample pulse will be a very 'narrow' pulse as indicated on waveform plotted from oscilloscope results.
11. Referring to attached diagrams, Figure A indicates sample pulse alignment required with LVDT ac waveform output for the 'positive' core position.
12. Figure B indicates sample pulse alignment required with LVDT ac waveform output for the 'negative' core position. Figure C indicates sample pulse alignment at the LVDT null or zero position.
13. Connect Scope to Output Test Point 'Vout-11' (Pin-11).
14. Adjust DEMODULATOR GAIN pot (P3) and DEMODULATOR OUTPUT BIAS pot (P4) to obtain proper scaling at Demodulator Output Test Point 'Vout-11' (Pin-11) while moving LVDT over linear range. Ensure Demodulator Gain output (A4A) does NOT enter saturation.
15. Gain & Bias interaction is normal. Multiple iterations may be required. Continue to repeat steps until both are within specification without further adjustment.
16. Note: Operating points on ends of LVDT coils will become increasingly non-linear and should be avoided. An operating range over the ±Span of the LVDT core adjustment must be made to achieve optimum linear performance results.

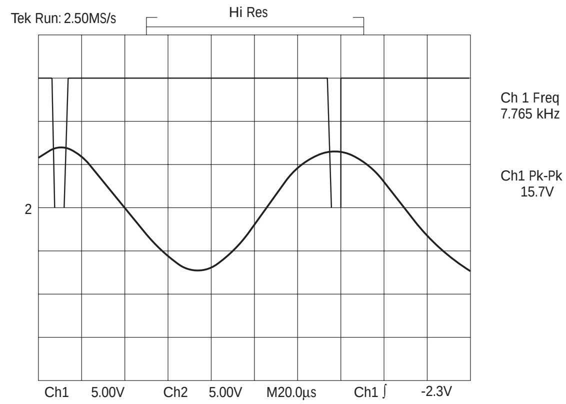



**Figure A**

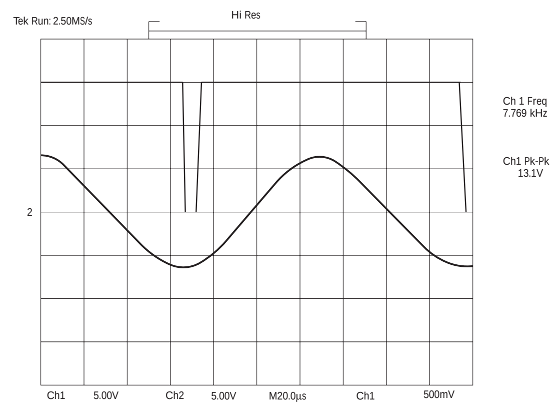



**Figure B**

## CIRCUITRY

This Module is a position 'Demodulator Card' used with the Linear Variable Differential Transformer (LVDT) on such applications as a 3-Stage Servovalve. It consists of an Oscillator (Exciter) section and a Demodulator section.

The EXCITER (Oscillator) section has a precise Waveform Generator (A1). The generated 'sine wave' is amplified by Stage A3 and Q1/Q2 switching transistors to excite the primary windings of the LVDT. The Exciter (Oscillator) output is monitored at test point 'Vout-13' and is adjustable from 5 to 11$V_{p\text{-}p}$ by EXCITER AMPLITUDE pot P2. The frequency of oscillation is adjustable from 100 to 2500Hz by EXCITER FREQUENCY pot P1.

The DEMODULATOR section consists of an input stage (A4) and Sample/Hold stage (A5) which is synchronized by the 'square wave' from the oscillator section and an Output Amplifier stage (A6). The return signal from the LVDT's secondary coils is applied to Terminals 5 and 3 (monitor test point 'Vin-5'). The Demodulated output is available at Terminal 11 (monitor test point 'Vout-11'). Potentiometer P3 provides adjustment of the Demodulated Signal Gain at Terminal 11. Potentiometer P4 provides Zero (Output Bias) adjustment of the demodulated signal.

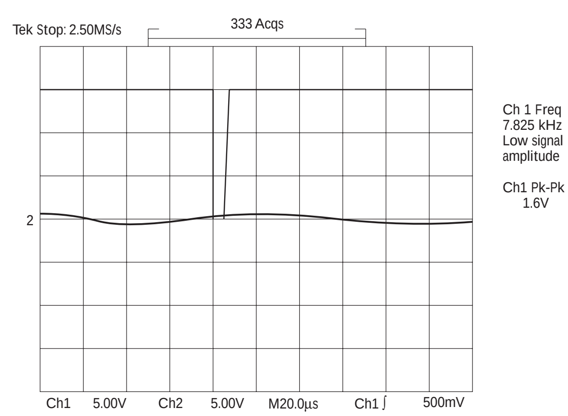



**Figure C**

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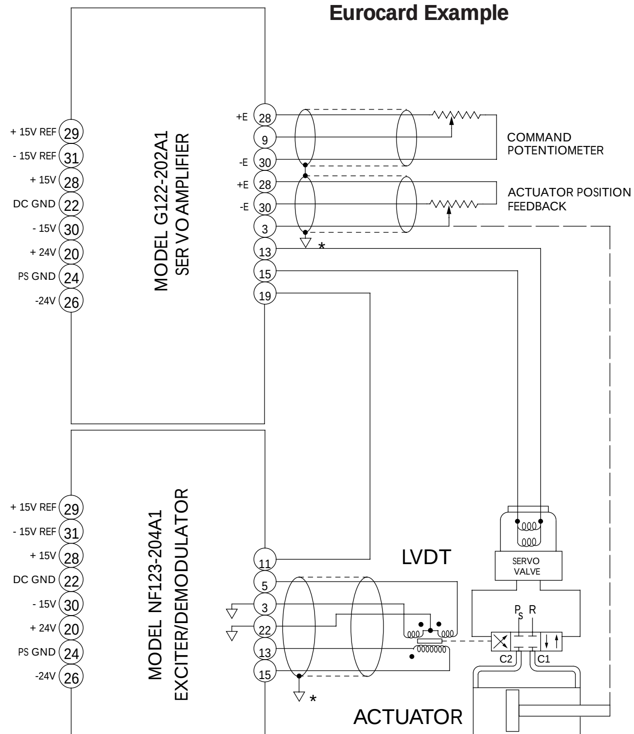
## CLOSED-LOOP POSITION CONTROL (3-STAGE VALVE)

Three-Stage servovalves are used in applications where high flow is required. The following examples illustrate the use of an Exciter/ Demodulator card to configure the three-stage servovalve LVDT for inner loop servo control.

The DC voltage from the Exciter/Demodulator is proportional to the position of the servovalve third-stage spool. The DC voltage, the servoamplifier, and the signal from a position feedback transducer create a position servo controller. The inner loop gain can be adjusted independent of the outer loop gain.

**Eurocard Example**




*Ground shield at servoamplifier end only.

(Power supplied by common power bus in the 19 inch rack.)

**Modifications to the G122-202A1 card:**

(Reference Moog Document G122-202A1)

- ➢ Set PID for P control.
- ➢ Set I/U jumper for current drive, jumper "1"
- ➢ Calculate proper resistor value for "Z4" to yield desired inner loop gain of three-stage valve. Insert resistor in position Z4.

**Suggested Setup Procedure:**

(Reference Moog Documents G122-202A1 and NF123-204A1)

1. Turn off hydraulic power and relieve pressure.
2. Set the GAIN pot (P2) on the G122-202A1 card approximately five turns from full counter-clockwise. (CCW)
3. Set the SCALE pot (P9) on the G122-202A1 card full clockwise. (CW)
4. Select resistor value for position Z4 to give proper inner loop gain of three-stage valve.
5. Apply electrical power.
6. On the G122-202A1 card, temporarily remove the feedback connection from terminals [3] and [19]. Adjust the BIAS pot (P2) for zero coil current with pin 9 grounded. Re-connect terminal [3]. Set the scale pot (P9) on the G122-202A1 full counter-clockwise. (CCW)
7. Apply hydraulic pressure.
8. Adjust the NF123-204A1 Exciter/Demodulator card for proper demodulator GAIN (P3) by monitoring the voltage at terminal [11]. Adjust the NF123-204A1 output BIAS pot (P4) for zero volts with the valve at null (zero current drive to the valve).
9. Re-connect terminal [19] of the NF122-202A1 card.
10. Increase the G122-202A1 GAIN pot (P2) clockwise until the system exhibits the desired sensitivity. Check the stability of the system throughout the full load range.
11. To activate dither, close jumper "dither". Use P4 to adjust dither level and P3 for dither frequency. Dither is rarely needed with Moog servo-valves.
12. Adjust the G122-202A1 BIAS pot (P1) for mid actuator position at zero command signal, or as desired.
13. Typical control applications will not always use P, I and D together. Refer to Moog detailed operations manual C31043, or contact a Moog application engineering representative to achieve desired result.

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