- ■ **Complete Set of Software Tools**
    Super μDriver Software for Waveform
    Creation and Instrument Control
- ■ **High-Precision Waveform Generators**
    Industry Standard Waveform Generator
- ■ **High-Voltage Precision Amplifiers**
    +1Vp to +150Vp, 4-Channel
    Signal Splitter

- ■ **Systems-Ready**
    Event Trigger Signals
    Internal Crystal Osillator Reference
    GPIB Interface
- ■ **Value and Invaluable Support**
    Best Value and Outstanding Support
    from the Waveform Generator Experts

System Overview

Pragmatic's 9014 MEMS Driver System is an accurate, highly stable signal source designed to drive MEMS rotating micro engines. This high-voltage, multi-channel, totally integrated system provides the necessary waveforms and instrument controls to drive MEMS devices with maximum reliability. Signal parameter stability is based on the digital synthesis techniques applied throughout the system. Frequency stability is assured by the internal crystal reference. Output frequencies range from dc to 5kHz (equivalent to 1 to 300,000 RPM), and the waveform fidelity is outstanding.

A typical system consists of Super μDriver software, two 2414A Waveform Generators and one 110A MEMS Driver Amplifier providing four flexible output channels. The channels may be operated in pairs using the built-in splitter or individually. The waveform generator may be programmed to output ideal MEMS drive signal, sinewaves, squarewaves or any arbitrary waveshape. Amplifier gain is fixed at x15 and the signal amplitude is set at the waveform generator.

Remote Programming

All four channels are remotely programmed using IEEE-488.2 (GPIB). Each channel may be automatically programmed in MEMS parameters. Waveforms and instrument settings may be created in and downloaded from Pragmatic's Windows-based MEMS system software, Super μDriver. The versatility of the 9014 accommodates complete parameter controls to meet all MEMS test requirements.

"Leave the MEMS driving to us."

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INSTRUMENTS, INC.

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9014 System Connection Diagram

System Diagram

The System Connection Diagram illustrates the interconnections between the major components of the system and indicates the functional interrelationships between the components. A typical setup consisting of two waveform generators and one MEMS driver amplifier, although any arrangement of the four channels is permissible, including four waveform generators.

For the application shown, two waveform generators are synchronized to each other. In this case, the frequencies are referenced to the internal crystal of the Master Unit.
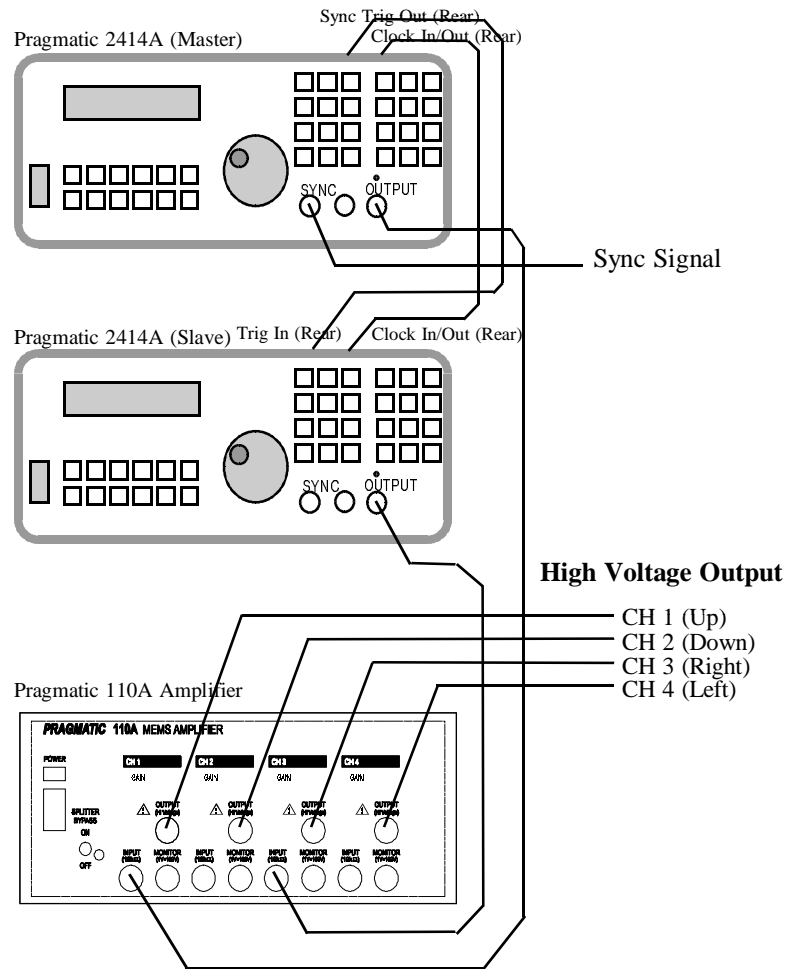
The Master sample clock determines the frequency at which the system will operate. This same sample clock is furnished to the Slave unit which guarantees synchronous operation.

Signal Precision

Each of the phase AWGs outputs a high-precision waveform achieved by using 12-bit resolution digital-to-analog converters. A second benefit provided by the AWG is the ability to mathematically compute the phase-shifted waveshape. Using this waveform description, precise control is provided by the 12-bit resolution AWG. Likewise, stability and repeatability is assured because the system is digital based.

A unique signal splitter circuit is provided to assure system simplicity, signal quality and proper signal levels at the load.

The high-voltage amplifiers for all channels are similar and the gain is fixed at 15. The output voltage range is +1Vpeak to +150Vpeak. In general, the system provides a total output current of 20m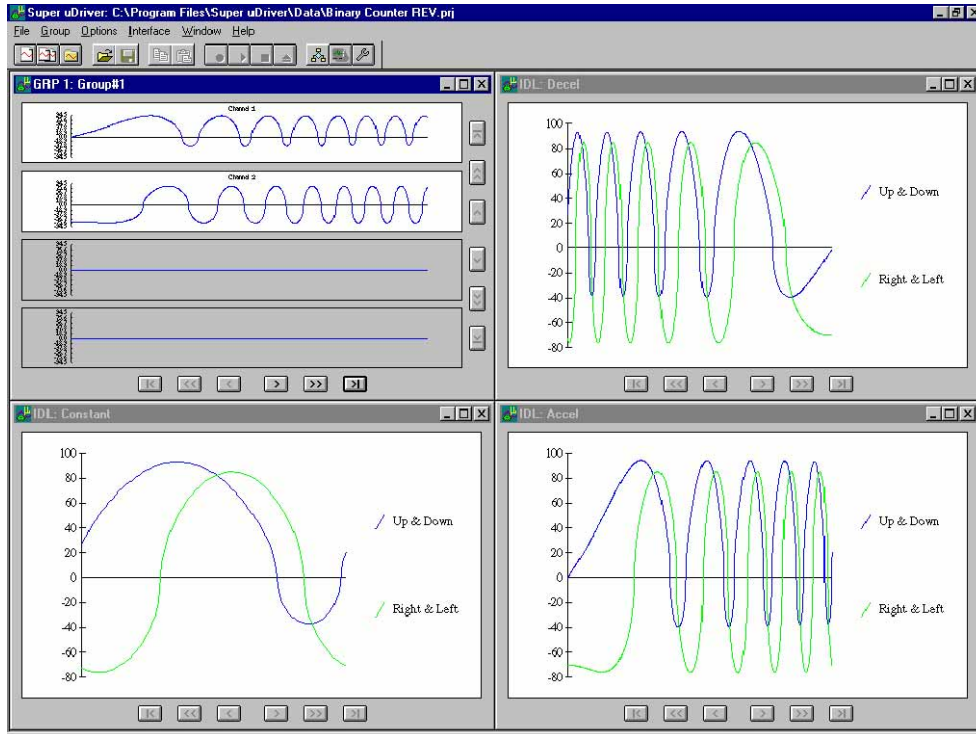A. All related components in each of the channels are interchangeable to offer convenient maintenance. The system is compact, flexible and versatile, and each channel is individually programmed in frequency, amplitude and waveshape.

System Software

Super μDriver was developed by Sandia National Laboratories to control the system and to provide the signals to achieve maximum device reliability. System control for all operating speeds are uniquely computed for every operating condition. Pragmatic Instruments is licensed to distribute this product.

Pragmatic 2414A (Master)
Sync Trig Out (Rear)
Clock In/Out (Rear)
SYNC   OUTPUT
Sync Signal

Pragmatic 2414A (Slave) Trig In (Rear)   Clock In/Out (Rear)
SYNC   OUTPUT

High Voltage Output
CH 1 (Up)
CH 2 (Down)
CH 3 (Right)
CH 4 (Left)

Pragmatic 110A Amplifier

PRAGMATIC 110A MEMS AMPLIFIER
POWER
CH1 CH2 CH3 CH4
GAIN GAIN GAIN GAIN
SPLITTER BYPASS
ON
OFF
OUTPUT (1V-150V)
INPUT (100mV) MONITOR (1V-150V)

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9014 System Control Software - Super µDriver™

UP & DOWN and RIGHT & LEFT waveforms are shown including the total waveform profile. Transients are minimized by the acceleration and deceleration signals at the beginning and end of the profile.

Ideal waveforms for each of the four electrostatic actuators are easily created by providing the proper parameters in this screen. All elements of the dynamic characteristics of the device are incorporated in the calculation of the waveform.

MEMS Engine Driver System

System Components

Model 2414A Arbitrary Waveform Generator with GPIB and Sequence (2 each)
Model 110A MEMS Amplifier
Super µDriver Software
BNC-HV Coaxial Cables (optional)

System Configuration

Number of Channels:	4 each, High-Voltage Output
Output Signal Connector:	4 each, BNC-HV Front Panel
Output Signal Monitor:	4 each, 1 per Channel
Output Event Signals:	Sync 1 (Front Panel), Sync 3 ,4 (Rear Panel) 1 set per Generator
Splitter Bypass	ON/OFF Switch (Front Panel)

Electrical Specifications

Description	MEMS Driver Amplifier Output
Voltage Range	+1 to +150 Vpeak
Voltage Adjustment	±0.1 V
Voltage Stability	≤ 0.1 % per 24 hours
Voltage Tracking	50 mVrms
Sine Distortion	≤ 0.1 %
Frequency Range	dc to 5,000 Hz
Current Output	20 mA per phase or total of 20 mA per Unit

Note: External current limiting series resistors is recommended to protect MEMS devices in actual use.

Computer Interface

GPIB:	IEEE 488.2-1987

Programmable Parameters

Frequency:	Controlled by Super µDriver Normal Mode-Sample Clock 20MS/s max.
Amplitude:	100% of Specified Range with 0.1% resolution
Output:	On or Off
Waveform:	Standard, User-Defined and Sequence

Waveform Creation Tools

Software:	Super µDriver
Operating System:	Windows 98 or 95
Computer Requirement:	Pentium 166MHz or better with 16MB RAM space
Interface Card:	National Instruments® AT-GPIB/TNT Card (or equivalent)

Environmental

Operating Temperature:	0°C to +40°C, ambient
Specified Accuracy:	+23°C ±3°C
Storage Temperature:	-20°C to +60°C
Humidity Range:	80 % R.H.

General

Mains:	100/120/220/240 VAC, +5% -10%; 48 ~ 63Hz

	Waveform Generator (2414A)	MEMS Driver Amplifier (110A)
Power Rating:	55VA; 45Wmax	60VA; 50Wmax
Dimensions (H x W x L):	4.51" x 10.14" x 11.81"	4.51" x 10.14" x 11.81"
Weight (approximate):	10 lbs (4.5 kg)	12 lbs (5.1 kg)

Weight and dimensions are approximate. Errors and omissions excepted. Prices and specifications subject to change without notice.
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