ANALOG DEVICES

Video-based

Distributor Training

"ADI Signal Chain Selling The Instrumentation Market"

FOURTH DRAFT

PROMPTER COPY

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1

Analog Devices Program Open

Music:

2

Title Sequence:

"Signal Chain Selling"

"The Instrumentation Market"

Music:

3

Narrator sitting in an environment that looks like the control room of a television station. Monitors and lots of analog (really) equipment in the background.

Medium Shot that reveals the environment.

Narrator: *(on camera)*

Hello, I'm Marianne Milano. Welcome to another in a series of programs on Analog Devices' products and markets.

4

You can see the title slide in one of the monitors behind her. The technique we'll follow throughout the program is to support her on-camera performance with appropriate visuals. They will either be on the monitor or superimposed on

the video in the frame. In some cases we'll preview graphics by showing them in the background first. We'll also have the narrator turn and use the control room equipment to bring up the appropriate graphics and the correct time. This will add a little action to the program, and make it seem a little more "friendly."

5

5

Cut to a closeup from a different camera angle.

In this program, we'll again stress the importance of understanding the analog opportunity in new products and new applications. Keep in mind that many products with a primarily "digital" design still have a significant analog section.

6

Back to a medium shot from the original position. Our narrator gestures to one of the television monitors in the background which contains the generic graphic

We'll use this generic signal flow diagram and several application-specific diagrams to show you that once you determine the key characteristic of any new design, it's easy to identify the opportunity in the analog section and then sell Analog Devices' products.

7

Narrator: Medium Shot

Narrator turns to the graphic in the monitor as if about to control the electronic process of rebuilding the block diagram.

Narrator actually pulls fader handle to dissolve to full screen graphic

Let's look at the generic signal flow diagram first.

8

8

Full Screen Signal Flow with every element at full value.

This signal flow diagram shows many of the common elements found in the analog section of new designs.

9

Full screen subdued graphic with analog cloud at full value.

Temperature, force, sound, pressure, and light superimposed over the graphic.

The analog world is a real world of temperature, force, sound, pressure, and light. Any product that performs digital processing on real world signals requires an analog "front-end."

10

Sensor dissolves onto the subdued graphic and shrinks into its correct position sensor

These products all use sensors to detect changes in real world signals.

11

Narrator on-camera Close-up.

The signals from the sensors are usually weak. They must be

amplified and filtered before they're converted to digital form and processed by the microprocessor or DSP. This amplification and filtering step is called analog signal conditioning.

12

12

Shoot narrator on-camera MS with monitor for everything even though we will stay mostly on the full screen graphic.

Shrink Op Amp, Sw/Mux, and Signal Processing Components.

Here, you'll find opportunities to sell op amps, switches, muxes, and signal processing components. The nature of the application and the characteristics of the sensor determine the specific components required.

13

Shrink ADC to fit in place.

After conditioning, the signal is converted from analog to digital form. This requires an A to D converter.

14

Introduce, shrink, and place interface.

If the converted digital signal has to go "off the board", for example, to a printer, interface products, such as line drivers and receivers

will be part of the design.

15

Introduce and shrink DAC, Reference, and Op Amps

After digital processing, the signal will usually be converted back to analog before it can be displayed. This requires a DAC, a reference and more Op Amps.

16

16

Back to our narrator on-camera in a Medium shot that shows the monitors in the background.

Now it's time to show the match between this diagram and specific applications within the Instrumentation market.

17

Introduce Graphic for the Instrumentation Market. Three stock photos together with title?

Music:

18

On -camera narrator appears again with the Instrumentation Market graphic on a monitor to the side.

ADI products have always been strong sellers in this market. Industry projections indicate that this market will continue to grow steadily and generate a significant demand for our products.

19

Full Screen **Graphic shows:**

Instrumentation Market

Of the seven sub-markets that make up the instrumentation

Medical Instrument
Analytical
Test and Measurement
Avionic
Automatic Tester
Nuclear
Laser

(Highlight the three, dissolve the others away)

market, we're going to focus on three that rely heavily on our advanced products.

20

20 .

Graphic pulls out the three important categories:

Medical Instrument
Test and Measurement
Analytical

They're the most important because they offer **you** the greatest sales opportunity.

21

The **Medical Instrument Market** becomes a title slide for the application list.

We'll now look at applications from the Medical Instrumentation market

22

The Stock Photo appears under the title:
MEDICAL INSTRUMENTS

23

Narrator on camera Medium Shot with the monitors in the background

Possibly covered by graphic.

Narrator:
The medical instrument market is evolving rapidly.

24

Graphic Scroll of the sub-categories
Shoot Narrator on-camera CU as well.

Manufacturers are continuously increasing the scope of technology available to their

customers. New products are continually introduced to the market.

25

25

Graphic scroll with all of the potential product areas ends with a freeze on patient monitoring and diagnostic equipment.

We'll focus on two applications, patient monitoring, and diagnostic equipment

26

Narrator on-camera MS with monitors.

Patient care requires constant monitoring of many analog signals including blood pressure, body temperature, and heart functions.

27

Narrator on-camera

Patient monitoring equipment detects these signals, analyzes them and displays them.

28

Narrator on camera moves fader handle on switcher to bring up the first application signal flow diagram on one of the monitors in the background along side the generic signal flow diagram.

This application usually requires low noise, high precision, low speed products. In these applications, low power dissipation is also critical

29

Talent points to cloud.

In patient monitoring, real world analog signals are generated by the human body.

30

30

Talent moves fader bar again to bring up the patient monitor graphic full screen.

A pressure sensor measures changes in blood pressure, a temperature sensor reads temperature, and an electrical sensor monitors heart functions.

31

Patient Monitor Diagram Full-screen

Here's a typical signal flow diagram for a patient monitoring application.

Op Amps after the sensor are dissolved in large then "flown" into position.

Shoot talent in CU for all of these sections where a full screen graphic is probable.

As the first step in signal conditioning, the weak signals from the sensors must be amplified. That generally requires a low noise, low input current operational or instrumentation amplifier after each of the sensors.

32

Introduce elements large then place them into the diagram

Next, you'll find a precision filter. This filter is designed to clean the signal by removing unwanted external "noise" such as AC power signals.

33

33

Perhaps dissolve back to talent on camera as we go through the longer applications. This would be a Close-up.

Filters like these are composed of a series of op amps and passive components such as resistors, capacitors and inductors. Their most important characteristic is DC precision and stability.

34

Back to the graphic full screen and elements are introduced and positioned.

Normally, after a signal is filtered, it's amplified. In this part of the circuit, , you'll find single or multiple Op Amps as the central gain element.

35

Introduce and place multiplexer

After all the inputs are amplified and filtered, they may have to be multiplexed into one signal path. That's where the multiplexer comes in.

36

Perhaps off the graphic and back to the talent on-screen framed with the two monitors in the background

Place Op Amp

The output of the mux then goes to another op amp. An op amp is frequently required before the A to D converter so the signal can be adjusted to match the input requirements of the ADC.

37

Talent on-camera in Close-up..

Converting analog patient monitoring signals to digital data normally requires an ADC with resolution from 16 to 20 bits. Low power consumption is also critical, particularly in portable instruments.

38

Back to the graphic full.
Place Interface and power management

Depending on the peripherals, you might find an opportunity to sell interface and power management products around the

microprocessor.

39

Place appropriate graphic element

External peripherals, like printers, are driven by interface products

40

Graphic full

Power management products might be included to monitor power supply voltages and protect the system from fluctuations in supply voltage.

41

41

Place DSP

The Digital Signal Processor, or DSP, processes the digital data to extract the required information.

42

Graphic full. We might occasionally go back to the narrator 0n-camera.

Place DAC element

The final part of this diagram shows a Digital to Analog Converter after the DSP or microprocessor. This DAC feeds the signal to an output device such as a display or printer.

43

Back to the talent on camera. Talent moves fader handle to bring up the next product category.

We then go to the graphic full screen.

We then dissolve in the photo if we have one.

The next product category we'll focus on is medical diagnostic technology. This differs from patient monitoring in that it actively transmits signals into the human body and then measures the return or echo. It includes

applications such as Magnetic Resonance Imaging and Ultrasound equipment.

44

Back to the talent on camera

We'll examine an ultrasound application.

45

45

Ultrasound title. Stock Photo?.

Ultrasound products are sonar-like devices that process and display reflections from signals transmitted into the patient.

46

Graphic full screen.

Highlight/place transducer subdue the rest of the diagram.

Also shoot the talent in closeup in case we need to return to the narrator.

The sensor in this application is an array of 256 transmit and receive transducers. The transmitting section of the transducer emits a signal in the range of 1 to 10 Mhz. The signal travels through the patient, bounces back, and is detected by the receive transducer.

47

Place these elements as they are mentioned.

The gain of the transmitted signal is controlled by a variable gain amplifier, which in turn is

controlled by an 8-bit Digital to analog converter.

48

48

Return to the talent in close-up for some of this explanation.

The reflected signal is first processed by a time-gain amplifier. The TGA applies more amplification to those reflected signals that have the longest elapsed time from transmission to reception. These are the signals that have traveled deep into the patient's body.

49

Graphic Full. We will shoot the narrator on-camera if we have to cut away to the narrator at any point. Op Amp is placed on the diagram

Once amplified, the input signal is processed by another op amp. This Op Amp conditions the signal before it gets to the ADC.

50

Introduce and Place ADC

A typical ADC would have 10 bits of resolution and operate at speeds of up to 40 mega samples

per second.

51

Introduce and place DSP

In order to extract the needed information, the signal is then processed by the DSP.

52

52

Place elements as they are mentioned.

After this processing, the information is converted back to analog. This may require one or more video DACs. The output of the DAC may be buffered by another Op amp and then sent to a VCR and monitor.

53

Place elements as mentioned

Note: Is it 18 Bit??

The audio signal is generated by an **18**-bit audio DAC. An audio preamplifier and a power amplifier are used to drive a speaker. This is a low frequency signal path.

54

Back to narrator on-camera and then to at title slide for the next sub-category.

Rene to check whether "other substance analyzers" is correct sub-category for

We move now to analytical products. This sub-category includes applications such as chromatographs,

Blood Analyzer

spectrophotometers, spectrometers, and *other substance analyzers*.

55

55

Graphic build to Analytical title which is a stock photo under the application title.

56

Talent on camera. At the end of this paragraph talent moves the fader handle to bring up the next graphic

In this category, we'll take a look at a Blood Analyzer. This application is another example of a low speed, precision signal path.

57

Graphic full then subdued to reveal sensor.

The real world signal in this case is light. The sensor is a photo diode that measures changes in light as it passes through a Blood sample. There might be as many as 32 of these sensors in an array.

58

introduce and position Op Amp.

The output signal from each

Talent on camera if necessary.

sensor is very small, so the first step is amplification. After every sensor, a very low input current, low noise op amp boosts the signal.

59

59

Introduce and place low pass filter.

We'll also shoot the narrator on-camera in case we need the footage.

A low pass filter is next. The requirements here are similar to the filter we described in the patient monitoring application.

60

introduce and place MUX

32 sensor array outputs are then multiplexed into one signal path. This mux has a characteristic of very low "on" resistance.

61

Introduce and place Op Amp

After the mux, a buffer op amp is required before the input of the ADC.

62

Introduce and Place ADC.

Place Reference

The ADC in this application typically has 16 bits of resolution and a 5 kilohertz sampling rate. Here, as is often the case, a

voltage reference is required..

63

Introduce and Place DSP

The DSP or microprocessor processes the data to determine the characteristics of the fluid or gas being analyzed.

64

64

Highlight interface and management products.

As with the other applications, around the DSP or microprocessor you'll find an opportunity to sell interface and power management products.

65

Highlight Display and Printer

After the DSP, the results are routed to a display and a printer.

66

Narrator on-camera

With variations appropriate to the material being analyzed, this signal flow diagram is fairly representative of many products in the analytical instrument sub-category.

67

Narrator moves fader handle to bring up the next graphic.

The final area we'll cover in this program is the Test and

Measurement sub-category.

68

68

Word Graphic Build

We'll examine one application from this important area: Oscilloscopes.

69

Talent on camera

The input to Oscilloscopes is an electrical signal picked up by a probe.

70

Graphic full then subdued. Digital Frame storing oscilloscope

Graphic build. Introduce ICG

The first step in the signal path is manual or automatic input gain control.

71

Graphic highlight attenuator

The attenuator adjusts the input signal in order to maximize it without overdriving the instrument.

72

Highlight programmable gain amplifier

The next component, a high

speed programmable gain amplifier works together with the attenuator to maximize the signal input to the ADC.

73

73

Introduce and place ADC

The performance and cost of an oscilloscope is dependent on the performance of the ADC. It's the heart of the oscilloscope.

74

Narrator on camera

Depending on the product, the ADC world require a resolution of 8-12 bits at speeds of 10 to 500 megasamples per second.

75

Narrator on-camera

The trade-off here is speed vs. resolution as well as cost.

76

Highlight elements as they are mentioned

After the ADC, the digital signal goes to a buffer memory where the waveform can be stored for processing by the DSP or held momentarily before being sent

through a DAC to an analog display.

77

77

Introduce and place DSP

DSPs are used to average or filter the waveform based on what the user wants to analyze. Like the other applications, the output is converted back to analog form by a DAC and video amplifiers.

78

Narrator on-camera

We can't leave the Test and Measurement sub-category before telling you again these products offer you a high volume sales opportunity.

79

Narrator on-camera. Then dissolve to a each of the application signal flows to show how the generic diagram matches the specific diagrams

That brings us to the end of this program. Elements from the generic signal flow diagram we introduced at the beginning of this program are found in each of

these application specific diagrams.

80

Back to the generic signal flow diagram at the end of the review.

The generic signal flow diagram is a model you can use for most of the products that fall within the Instrumentation Market.

81

Narrator on-camera

Understanding recurring signal flow patterns is the best way to sell our products.

82

Narrator on camera

Thanks for your time. See you in our next video.

83

Narrator on camera

Good selling.

84

Closing graphics

Music: *(optional)*

85