PREAMBLE INSTRUMENTS

OPERATOR'S INSTRUCTION MANUAL

1850A and 1855A

DIFFERENTIAL AMPLIFIERS

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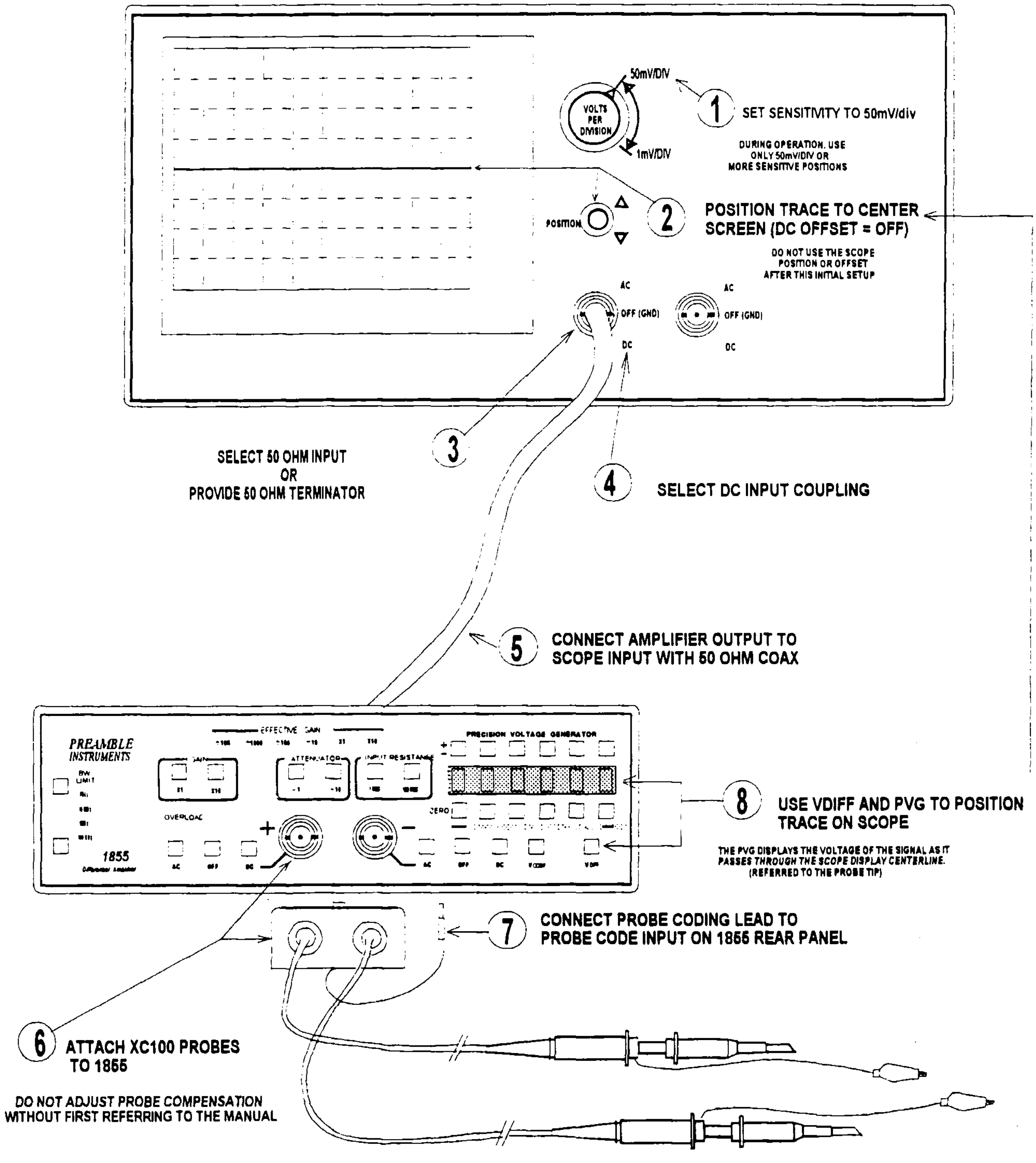
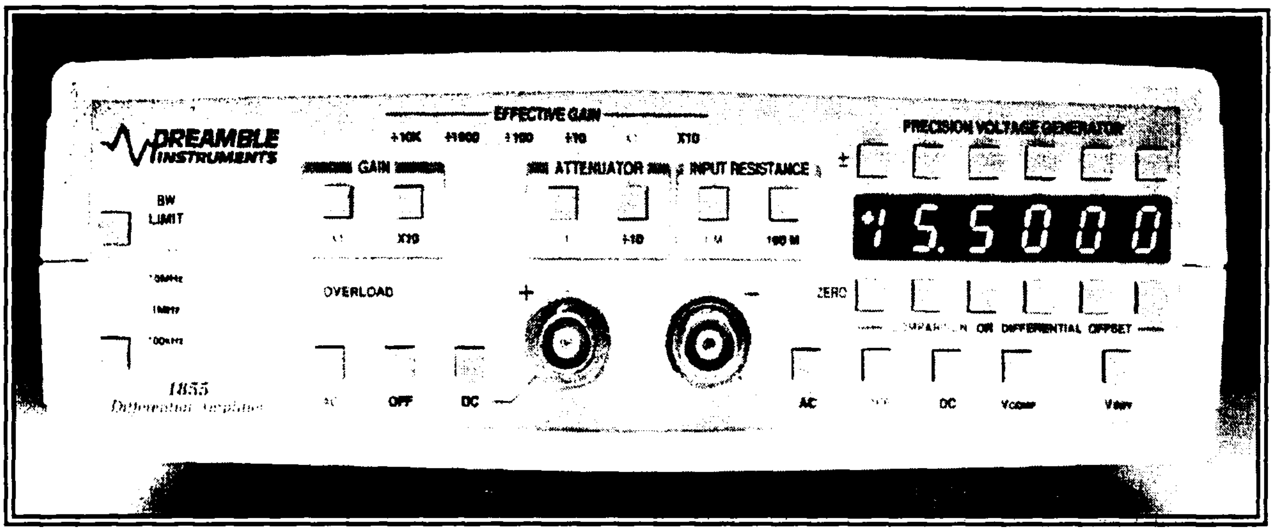
INITIAL SCOPE AND 1855 SETUP



SECTION 1
SPECIFICATIONS



INTRODUCTION

The 1850A and 1855A are stand-alone high performance 100MHz differential amplifiers. They are intended to act as signal conditioning preamplifiers for oscilloscopes, digitizers, network analyzers and spectrum analyzers, providing differential measurement capability to instruments having only a single-ended input. When used with an 1850A/1855A, most good quality oscilloscopes can obtain Common Mode Rejection Ratio (CMRR) and overdrive recovery performance that was previously unobtainable in any product.

Amplifier gain may be set to 1 or 10. A built-in input attenuator may be separately set to attenuate signals by a factor of 10, allowing gains of 10, 1, or 0.1 and common mode dynamic range of ±15.5V (÷1) or ±155V (÷10). Optional probes increase the maximum input signal and common mode ranges in proportion to their attenuation ratio, but not exceeding their maximum input voltage rating. Effective gain of the 1855A, including probe attenuation, amplifier gain and attenuator settings, is automatically displayed.

The 1855A has a bandwidth of 100 MHz, but any one of the three 3-pole bandwidth limit filters may be selected to reduce bandwidth to 20MHz, 1MHz or 100kHz to limit noise above the frequency of interest.

The 1850A/1855A output is carefully limited at ±500mV so that the oscilloscope is not overdriven by large inputs. This allows many oscilloscopes to directly measure the settling of D/A converters with 14 bit (60ppm) precision, better than any other differential comparator.

The 1855A features a built-in Precision Voltage Generator (PVG) that can be set to any voltage between ±15.5 volts (±10 volts in Differential Offset mode) with 100μV resolution. Each digit of the voltage generator output can be individually incremented or decremented and the sign changed between + and –. The PVG's output can be selected as an input to the inverting (–) input of the amplifier for operation as a differential comparator or applied internally as a true differential offset voltage. The voltage is also available to be used externally through a rear panel connector. On the 1850A, this connector becomes an input through which the user can apply an external voltage to achieve the same differential offset and comparison functions.

The 1850A/1855A operates from 100 to 250 VAC line without line switching.

High performance differential probes such as the Preamble Instruments XC100 10X/100X high CMRR probes are recommended.

1850A/1855A SPECIFICATIONS

GENERAL:

Amplifier gain:	1 or 10
Gain accuracy:	±1%
Bandwidth:	>100MHz
Rise time:	<3.5ns
Output impedance:	50 ohms
Intended output load:	50 ohms
Maximum output:	limited at ±0.50V into 50 ohms
Input attenuation:	÷1 or ÷10
÷10 ATTENUATOR accuracy:	±0.05%
Max differential linear input:	
(X10 GAIN, ÷1 ATTENUATOR):	±0.05V or ±0.5V with X10 probe
(X1 GAIN, ÷1 ATTENUATOR)	±0.5 or ±5.0V with X10 probe
(X10 GAIN, ÷10 ATTENUATOR)	±0.5 or ±5.0V with X10 probe
(X1 GAIN, ÷10 ATTENUATOR)	±5.0 or ±50V with X10 probe
Maximum input slew rate:	
(**÷1 ATTENUATOR**, X1 probe):	0.5V/ns
(**÷10 ATTENUATOR** or X10 probe):	5.0V/ns
(**÷10 ATTENUATOR** and X10 probe):	50V/ns
(**÷1 ATTENUATOR** and X100 probe):	50V/ns
(**÷10 ATTENUATOR** and X100 probe):	500V/ns
Input noise (**X10 GAIN**):	<4nV/sq rt Hz. broadband
DC drift (**X10 GAIN**):	50μV/°C
Common mode rejection ratio:	See Figure 1-1
Max common mode input:	
(**÷1 ATTENUATOR**):	±15.5V (**X1** or **X10 GAIN**)
(**÷10 ATTENUATOR**):	±155V(**X1** or **X10 GAIN**)
(**÷10 ATTENUATOR** and X10 probe)	±1.55kV(**X1** or **X10 GAIN**)
Input resistance:	
(**÷1 ATTENUATOR**, **X1** or **X10 GAIN**):	1 megohm or 100 megohms
(**÷10 ATTENUATOR**, **X1** or **X10 GAIN**):	1 megohm
Input capacitance (**÷1 or ÷10 ATTENUATOR**):	20pF
Bandwidth limit filters (1855A only):	20MHz, 1.0MHz and 100kHz
Filter characteristics (1855A only):	18dB/octave (3-pole Bessel)
+INPUT selections:	**AC**, **OFF** (Protegra), **DC**
–INPUT selections:	**AC**, **OFF** (precharge), **DC**, V_{COMP}
Input coupling capacitor:	0.1μF, 400VDC
Input gate current (**X1 and X10 GAIN, ÷1 ATTENUATOR**):	<10pA, 0–45°C
Input protection:	protected to ±250V, automatic input disconnect with manual reset

DIFFERENTIAL OFFSET (V_{DIFF}) MODE:

Differential offset range (referred to input):	
(X10 GAIN, ÷1 ATTENUATOR):	±1V
(X1 GAIN, ÷1 ATTENUATOR):	±10V
(X10 GAIN, ÷10 ATTENUATOR):	±10V
(X1 GAIN, ÷10 ATTENUATOR):	±100V
(X1 GAIN, ÷10 ATTENUATOR, X10 probe)	±1.0kV
Differential offset accuracy:	
(X10 GAIN, ÷1 ATTENUATOR):	0.1% + 50V
(X1 GAIN, ÷1 ATTENUATOR):	0.1% + 500V
(X10 GAIN, ÷10 ATTENUATOR):	0.15% + 500V
(X1 GAIN, ÷10 ATTENUATOR):	0.15% + 5mV

COMPARISON OFFSET (V_{COMP}) MODE:

Effective comparison voltage range:	
(÷1 **ATTENUATOR**):	±15.5V (**X1** or **X10 GAIN**)
(÷10 **ATTENUATOR**):	±155V (**X1** or **X10 GAIN**)
(X10 probe and ÷10 **ATTENUATOR**):	1.55kV (**X1** or **X10 GAIN**)

PRECISION VOLTAGE SOURCE (1855A only):

Output range:	±15.5V
DC accuracy:	0.05% of reading +500µV (0° to 50°C)
Resolution:	100µV
Control:	All digits are addressable. Digit carries to next decade
Temperature coefficient:	typically <5ppm/°C of full scale
Type:	Oven stabilized buried Zener
Output:	Applied to inverting input and available at rear panel
PVG AUTO ZERO:	Sets output to zero when 0.0 volts selected and in error by more than 0.5mV thereafter

POWER REQUIREMENTS

Line voltage requirement:	100 to 250VAC
Line frequency range:	48 - 66Hz
Power requirement:	35 W maximum

ENVIRONMENTAL CHARACTERISTICS

Operating Range:	0 to 50°C
Non-Operating:	–40 to 75°C

PHYSICAL CHARACTERISTICS

Height:	7.29cm (2.87")
Width:	21.2cm (8.36")
Depth:	23.2cm (9.12")
Weight:	2.15kg (4.75lb)
Shipping Weight:	3.12kg (6.88lb)

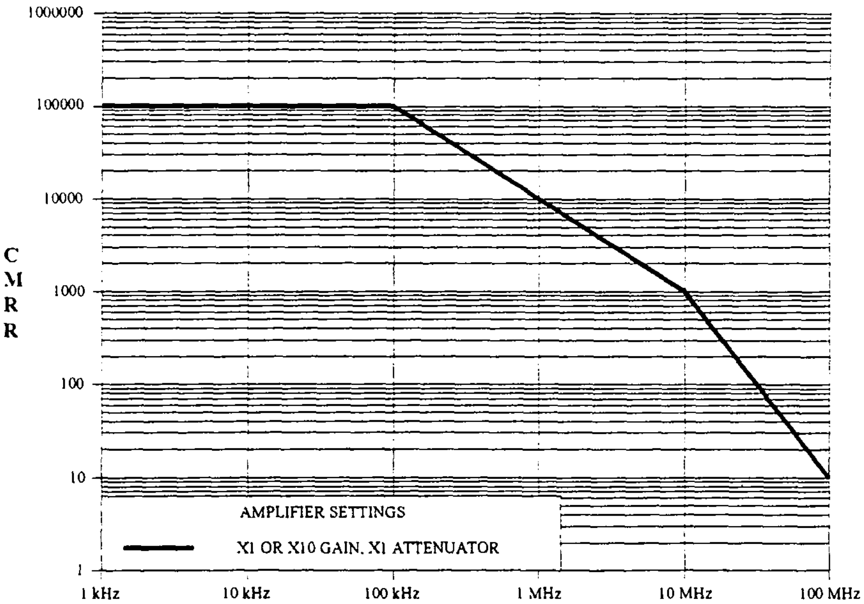


Figure 1-1. CMRR vs Frequency

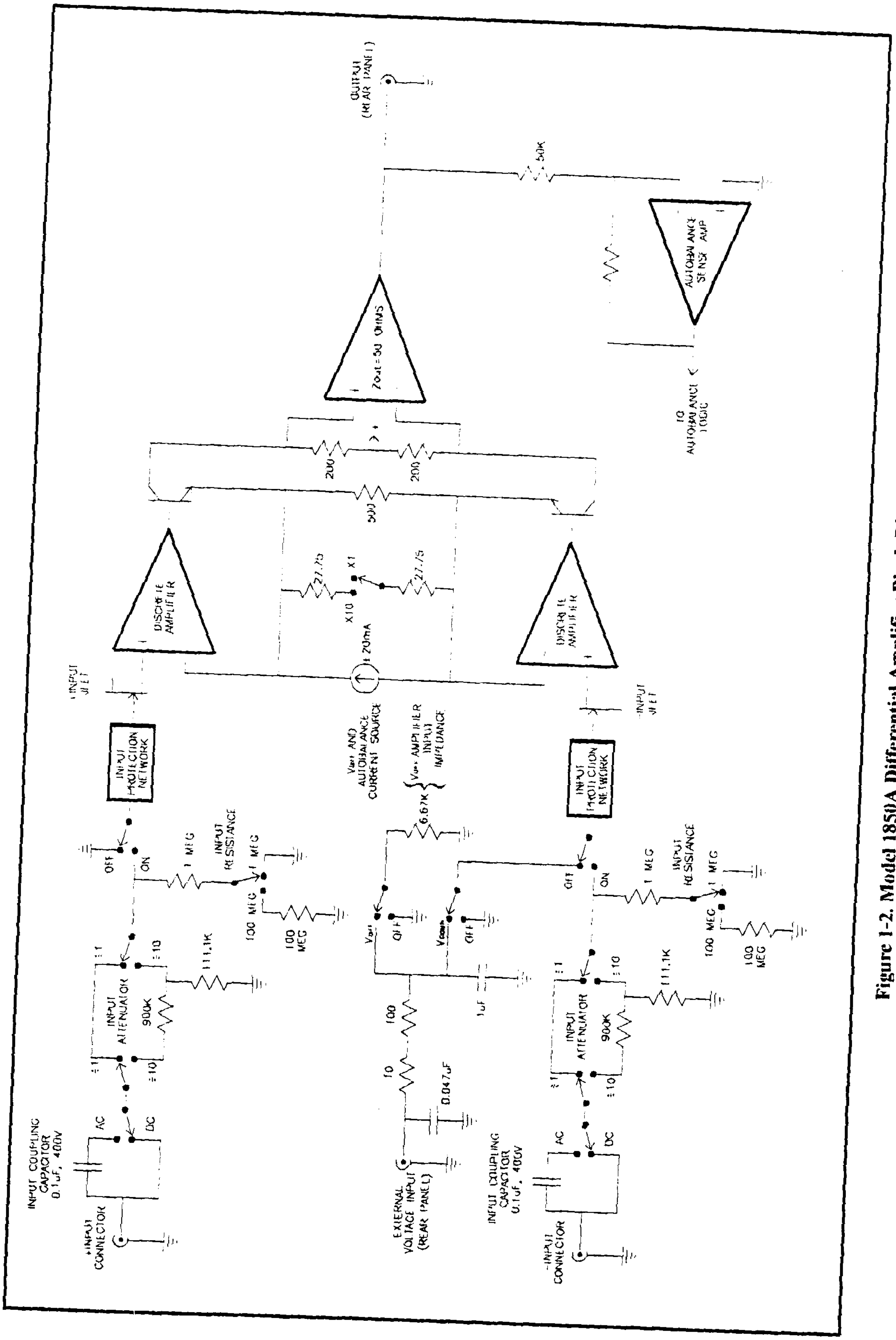


Figure 1-2. Model 1850A Differential Amplifier Block Diagram

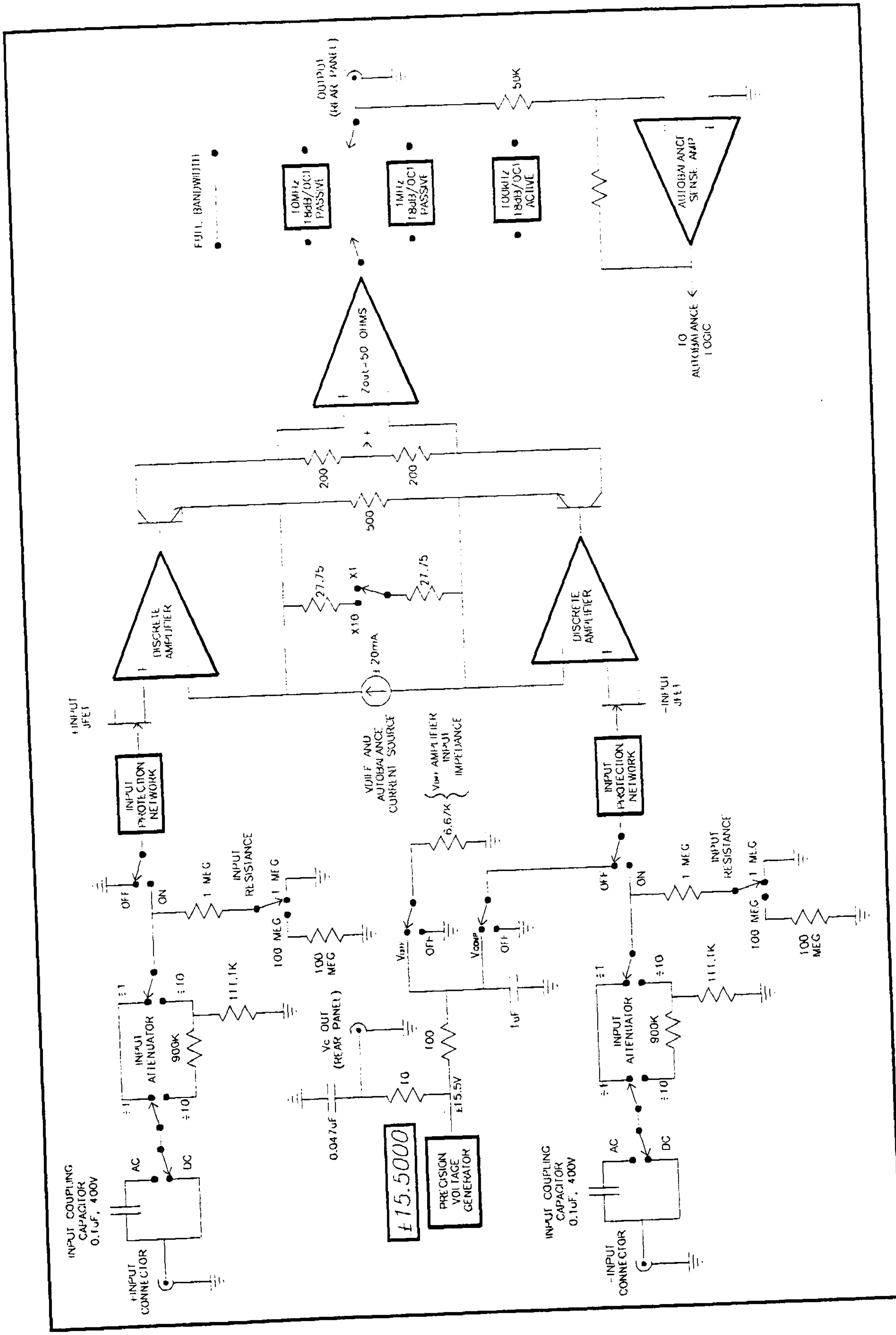


Figure 1-3. Model 1855A Differential Amplifier Block Diagram

SECTION 2
OPERATING INSTRUCTIONS, CONTROLS AND INDICATORS

FRONT PANEL

ATTENUATOR

Signals connected to the **+INPUT** and the **–INPUT** are connected either directly to the 1850A/1855A's amplifier inputs or to the input attenuators. The input attenuators are passive networks which divide each signal by ten.

In ÷1 mode the front panel input connectors are directly connected to the 1850A/1855A amplifier's differential inputs.

In ÷10 mode each front panel input connector is connected to a passive 1 megohm attenuator. The attenuator output is connected to the 1850A/1855A amplifier's corresponding differential input. The signal at each input is attenuated by a factor of ten.

GAIN

The 1850A/1855A amplifier gain (amplification) is selectable between **X1** and **X10**. The amplified signal appears at the rear panel **AMPLIFIER OUTPUT** connector.

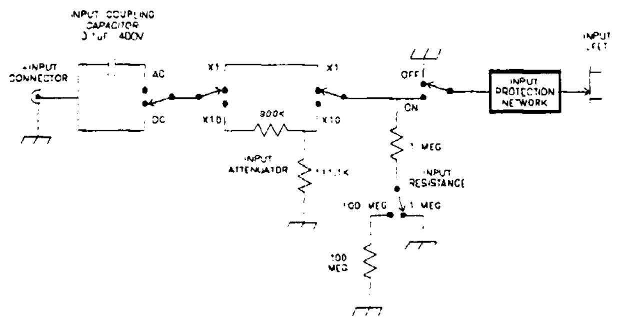
A signal connected to the **+INPUT** will maintain its polarity at the output connector. A signal connected to the **–INPUT** will be inverted in polarity.

Proper gain is obtained when the 1850A/1855A drives a 50 ohm load such as an oscilloscope with input impedance set to 50 ohms. An oscilloscope with only a 1 megohm input impedance available should have a 50 ohm coaxial termination placed on its input connector. The 1850A/1855A is then connected to the oscilloscope through the coaxial termination.

The amplifier gain and the input attenuator are individually selectable to provide versatility. For example, the comparison voltage range is changed from ±15.5000 to ±155.000 volts by changing the **ATTENUATOR** from ÷1 to ÷10. The overall gain can still be set to either 1 or 0.1 by selecting the **GAIN** mode, **X10** or **X1**, as desired.

AUTO ZERO is a feature invoked when either the **X1** or **X10** button is pushed, even if a different gain is not selected. AUTO ZERO momentarily sets the input coupling to **OFF** and determines the offset necessary to set the output at 0 volts within about 25μV. During this process the front panel is unresponsive. When finished, the input coupling returns to its previous mode. AUTO ZERO usually takes less than one second. This handy feature allows the operator to DC balance the 1850A/1855A simply by pushing the **GAIN** button which is already illuminated. When changing gains, the AUTO ZERO feature is automatically invoked, freshly adjusting the amplifier's DC balance.

+INPUT COUPLING (AC OFF DC)



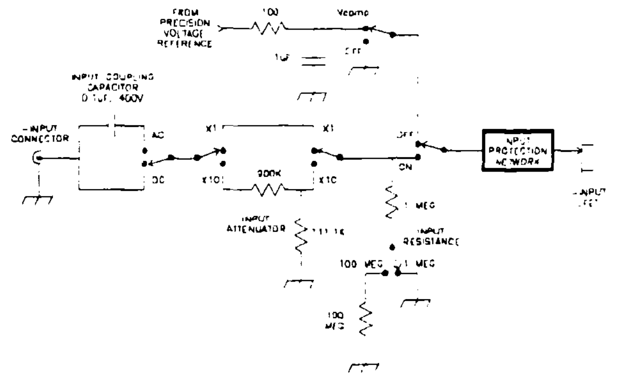
In **OFF** mode, the input connector is disconnected from the amplifier input, and the amplifier input is connected to ground. The AC coupling capacitor is connected between the **+INPUT** and ground through 1 megohm (either the input attenuator or the input resistor), independent of the **INPUT RESISTANCE** selected. In this mode, the AC coupling capacitor is quickly charged to the average DC input voltage. **OFF** mode is also referred to as precharge mode. Precharge is particularly useful when planning to AC couple and measure voltages in excess of 19 volts. The 1850A/1855A input coupling is set to **OFF** and connected to the circuit under test. When the **+INPUT** is changed from **OFF** to **AC** mode, the coupling capacitor is already charged, and the trace properly centered on the oscilloscope screen. Additionally, the risk of tripping the input overload detector and automatically disconnecting the input is eliminated.

In the **AC** mode, the **+INPUT** is connected through an AC coupling capacitor to the amplifier input or the input attenuator. The coupling capacitor retains its charge when the input is switched to **DC**, making it possible to return to the same circuit without the precharge time. But this also makes it possible to discharge the coupling capacitor into another circuit under test if its DC voltage differs by more than approximately 19 volts from the voltage on the coupling capacitor. The discharge current is limited to about 70mA, but this could damage some circuits. It is therefore recommended that the **+INPUT** coupling first be changed to **OFF** (precharge) when measuring a new circuit point. This will safely recharge the AC coupling capacitor in less than 0.3 seconds. The AC coupling capacitor is 0.1μF and rated at 400VDC.

DC and low frequencies are attenuated by the AC coupling capacitor and the input resistance. With the **ATTENUATOR** set to ÷**10**, or set to ÷1 with the **INPUT RESISTANCE** set to 1 megohm, the low frequency cut off (-3dB point) is approximately 1.6Hz, lower than most oscilloscopes by a factor of 5. When the input attenuator is set to ÷**1**, the **INPUT RESISTANCE** may be set to 100 megohms, and the -3dB point is 0.016Hz. This extremely low frequency cut off is often handy in observing low frequency noise riding on large (up to 400 volts) DC voltages.

In the **DC** mode, the **+INPUT** connector is connected to the amplifier either directly or through the input attenuator, and the AC and DC attenuation are the same.

–INPUT COUPLING (AC OFF DC V_{COMP})



The **–INPUT** has the same coupling modes as the **+INPUT** plus one additional option, V_{COMP} (comparison voltage).

The 1855A generates a voltage controlled by the push buttons above and below the front panel numerical display. This voltage is called the Precision Voltage Generator (PVG). The 1850A does not have a built-in PVG and the user must supply a dc voltage in the range of -15.5V to +15.5V to the rear panel **OFFSET** connector.

In V_{COMP} mode, the 1855A's PVG is connected to the amplifier's inverting input through an internal filter designed to eliminate radio and television signal interference. The 1850A does not have the PVG, but uses an externally supplied voltage. See Page 2-6 for V_{COMP} operation with the 1850A.

The 1850A/1855A's amplifier subtracts the voltage applied to its inverting input from the voltage applied to its non-inverting input. The 1850A/1855A output is therefore zero whenever these two voltages are equal. For this reason, the voltage applied to the inverting input is called a comparison voltage, V_{COMP}.

V_{COMP} is often used to make precise measurements of large signals by comparing the accurately known V_{COMP} with the unknown signal. It can also be used to measure the actual voltage at any point of a waveform.

PRECISION VOLTAGE GENERATOR (PVG) output range is ±15.500 volts. The PVG is never attenuated by the input attenuator. Attenuation of the **+INPUT** signal by the ÷**10** input attenuator will cause the PVG to null out an input voltage up to ±155.00 volts which is ten times larger than the actual PVG voltage. When the 1855A is used with attenuating probes that feature readout, the PVG display is changed to indicate the voltage at the **+INPUT** probe tip which will bring the amplifier output to zero.

The **–INPUT** connector is not useable when V_{COMP} is selected.

V_{DIFF} (differential offset voltage) is an instrument mode rather than a type of input coupling. The V_{DIFF} mode allows the PVG (or an external source in the case of the 1850A) to inject an offset signal into the 1850A/1855A while still using both inputs for full differential operation. This mode can be used as a position control to move the trace on the oscilloscope screen in preference to using the oscilloscope's position or offset control. The oscilloscope's position and offset controls should always be set to zero so that the 1850A/1855A's dynamic range is properly centered. Operation of the 1850A/1855A using the V_{DIFF} function is the same as V_{COMP} except for the following:

- The **–INPUT** remains active, allowing full use of the 1850A/1855A as a differential amplifier.
- The maximum range of the PVG (1855A) or the external source (1850A) is ±10.000 volts in **X1 GAIN** and ±1.0000 volts in **X10 GAIN**. The effects of the ÷**10** input **ATTENUATOR** and probe attenuation are the same as when using V_{COMP}, i.e., any input attenuation multiplies the effective offset.
- The V_{DIFF} mode offset accuracy is slightly less than that obtained using V_{COMP}.

The 1855A's PVG display is changed to indicate the voltage that, if applied between the **+INPUT** and **–INPUT**, would bring the amplifier output to zero. When the 1855A is used with attenuating probes which feature readout, the PVG display is scaled to include the effect of probe attenuation.

INPUT RESISTANCE

When the input **ATTENUATOR** is set to ÷**1**, the input resistance can be increased from 1 megohm to 100 megohms. This is advantageous when measuring high impedance circuits or when AC coupling is needed with a very low frequency cut off.

Unbalanced source impedances can have an adverse effect on common mode rejection. For example, a differential source with impedances of 1000 and 2000 ohms, each loaded with 1 megohm will have a common mode rejection ratio (CMRR) of 1000 to 1. The common mode rejection ratio can be improved to 100,000 to 1 by using 100 megohm input resistance.

This limitation is also apparent when trying to make accurate measurements using V_{COMP}. A 10.000 volt reference with a 1000 ohm output impedance will be reduced to 9.9900 volts by the 1850A/1855A 1 megohm input resistance, introducing a 10mV error in the measurement. Increasing the input resistance to 100 megohms decreases this error to 100μV.

Oscilloscope inputs have a small input current which can cause an offset when measuring high impedance circuits. The offset can be observed by opening and shorting the input to ground. The 1850A/1855A has a temperature-compensated input current pull away (cancellation) which works in both the 1 megohm and 100 megohm **INPUT RESISTANCE** modes. Its input offset current is considerably less than that of most oscilloscopes.

EFFECTIVE GAIN (1855A ONLY)

Six lights (LEDs) across the top of the 1855A front panel indicate the total gain from the instrument input to output. When the **X1** light is lighted, the overall amplifier voltage gain (amplification) is unity. Similarly, **X10** indicates an overall amplification of ten times. ÷**10** indicates the voltage amplification is 0.1, and so forth.

When Preamble Instruments or other encoded probes are properly used, the effective gain includes the probe's attenuation factor.

BW LIMIT (1855A ONLY)

FULL — The 1855A amplifier's full bandwidth, over 100MHz, is passed to the oscilloscope, spectrum analyzer or digitizer. Frequency response and transient response are essentially independent of the oscilloscope's input impedance.

20MHz — A 20MHz three pole (18dB/octave) filter allows the 1855A to reduce extraneous noise. This filter is a passive LC design and is intended to drive a 50 ohm load. Without the load, the filter's frequency response and transient response are altered.

1MHz — The 1MHz filter is of the same design as the 10MHz filter, and the same remarks apply.

100kHz — The 100kHz filter is an active filter with a 50 ohm output impedance. Transient and frequency response are independent of the load impedance. An internal adjustment minimizes the filter's DC offset.

PRECISION VOLTAGE GENERATOR (PVG) (1855A ONLY)

The PVG generates the voltage which is used in the V_{COMP} and V_{DIFF} modes and appears at the rear panel **OFFSET VOLTAGE** (PVG) output connector.

Above each digit is a push button which increments the corresponding digit by one when pushed. When held, the digit continues to increment, eventually incrementing the next higher digit.

Similarly, below each digit is a push button which decrements the corresponding digit.

The ± button above the left-most digit changes the PVG output polarity. The **ZERO** button below the left-most digit sets the output to zero and invokes the PVG's AUTO ZERO function.

The PVG AUTO ZERO resets the PVG output to zero to eliminate any drift which may have occurred in the PVG due to low frequency noise, or long term drift. PVG AUTO ZERO is invoked each time the **ZERO** button is pressed and reinvoked as needed if the output exceeds approximately 500uV. The PVG AUTO ZERO only functions when the PVG display reads zero.

OVERLOAD

When a signal which could damage the 1850A/1855A has been applied to either input connector, the 1850A/1855A protects itself by disconnecting the signal. The input coupling mode changes to **OFF**, and the **OVERLOAD** light is turned on.

Remove the offending input. The 1850A/1855A is reset and the **OVERLOAD** light goes out when any of the input coupling modes (**AC**, **OFF**, or **DC**) is selected.

When the **ATTENUATOR** is set to ÷**1**, a signal of approximately ±19 volts will cause the input to draw current and the **OVERLOAD** light to come on. Transients too rapid to be disconnected by the input coupling relay will draw up to about 70mA of input current. Inputs in excess of 250 volts may cause permanent damage to the 1850A/1855A.

The input is not disconnected when the **ATTENUATOR** is set to ÷**10**. The input attenuator is rated at 400 volts maximum continuous input.

REAR PANEL

POWER

Removing the power from the instrument by either turning the power switch to **0** (off) position or unplugging it will cause the oven to lose power and require time (about 30 minutes) for the PVG to stabilize. In high-humidity environments the time to stabilize may be much longer. In high humidity environments or when warm-up time inhibits usage, we recommend that the instrument be left plugged in at all times and the power switch left in the **1** (on) position.

Normal instrument operation is obtained with the power switch in the **1** (on) position. The instrument reaches its specified performance in 30 minutes.

In the 1850A, power is applied when the power switch is in the **1** (on) position.

PRECISION VOLTAGE GENERATOR OFFSET VOLTAGE (1855A ONLY)

The rear panel **OFFSET VOLTAGE** BNC (PVG) output connector, is a monitor of the Precision Voltage Generator (PVG). It is the same voltage as that applied to the **–INPUT** when the **–INPUT** coupling is V_{COMP} or internally to the 1855A when V_{DIFF} is selected. The **OFFSET VOLTAGE** output can be used either to monitor the PVG with a digital voltmeter (DVM) or as an input to one or more Preamble 1850As or 1855As. There is a 1.59kHz single-pole low pass filter between the PVG output and the **–INPUT** which removes radio frequency interference (RFI). This filter does not attenuate the PVG signal.

The PVG output is not attenuated by the input attenuator or probes, whereas the input signal is. Therefore the effective range of V_{COMP} is increased by a factor of 10 when the ÷**10 ATTENUATOR** is selected or a ÷10 attenuating probe is used to attenuate the input signal. The PVG numerical display reflects the attenuator setting and probe attenuation when the probe is readout encoded. As an example, if there are no probes attached, the ÷**10 ATTENUATOR** is selected and the display is set to read –155.000, the PVG output will actually be –15.5 volts.

The decimal in the display will be in the correct location to indicate the voltage at the PVG output when no probes are attached and ÷**1 ATTENUATOR** and **X1 GAIN** are selected.

The **OFFSET VOLTAGE** BNC (PVG) output also presents the same voltage used internally for differential offset when V_{DIFF} is selected. Because the PVG is applied to the amplifier to create a true differential offset, the relationship between V_{DIFF} and the voltage at the **OFFSET VOLTAGE** BNC (PVG) output (changes with the amplifier gain selection according to the following table:

FRONT PANEL SETTINGS			MAXIMUM PVG OUTPUT
GAIN	ATTEN	V_{DIFF}	
X1	÷1	±10V	±10V
X1	÷10	±100V	±10V
X10	÷1	±1V	±10V
X10	÷10	±10V	±10V

The maximum V_{DIFF} is multiplied by any probe attenuation factor. The 1855A front panel displays the correct offset referred to the instrument input. When using readout encoded probes which the 1855A senses, the PVG readout calculates the effective differential offset at the probe tip. Of course, both probes must have the same attenuation factor.

AMPLIFIER OUTPUT

The **AMPLIFIER OUTPUT** BNC is intended to be used with an oscilloscope, spectrum analyzer or digitizer having a 50 ohm input resistance. The 1850A/1855A **AMPLIFIER OUTPUT** impedance is 50 ohms. Without the 50 ohm load, the amplifier gain is twice the amount indicated on the front panel. Additionally, the signal presented to an oscilloscope (spectrum analyzer or digitizer) is as large as ±1 volt. This may cause the oscilloscope to significantly increase its overdrive recovery time, obviating one of the 1850A/1855A's important features, fast overdrive recovery.

With the **1MHz** or **20MHz** bandwidth limit filters selected, the 1855A amplifier is not well reverse terminated at high frequencies. When the oscilloscope's input impedance is 50 ohms, these passive filters work properly.

With **FULL** or **100kHz** bandwidth limit selections, the 1855A output impedance is 50 ohms, and the transient response is independent of whether the oscilloscope termination is present.

PROBE CODING INPUT (1855A ONLY)

This jack is to be used with Preamble Instruments probes and other probes that have multiple selectable attenuation factors. Other manufacturer's probes with standard probe coding capability will be properly decoded through the 1855A's front panel **+INPUT** BNC connector.

NEW FEATURES OF THE 1850A AND 1855A

The A versions of the 1850 and 1855 are microprocessor-controlled. The microprocessor sleeps except when processing a command and therefore generates no digital noise during normal operation. The new A version features are:

Power up indication Upon turn-on, the model number and firmware version are briefly displayed in the PVG readout. For example, 1855.11 indicates that the instrument is a model 1855A and the firmware version is 1.1.

20MHz BWL filter The only analog difference between the 1855 and 1855A is a change in the 1855's 10MHz bandwidth limit filter to 20MHz in the 1855A. Neither the 1850 nor the 1850A has a bandwidth limit filter.

Remote operation A **REMOTE** connector on the 1850A/1855A rear panel allows remote control of the instrument when connected to a ProBus-equipped LeCroy oscilloscope.

Retained settings All front panel settings, including PVG settings are retained when the instrument is turned off. The 1850A and 1855A turn on in the same state they were left.

The 1855A's PVG output will be in error by up to 40mV until full warm up unless the PVG was set to 0 when turned off. The PVG oven takes approximately 7 minutes to reach a stable temperature.

VCOMP/VDIFF settings retained Switching between **VCOMP** and **VDIFF** settings will not reset the PVG to 0. **VCOMP** settings greater than 10.0 volts will change to 10.0 volts when the PVG mode is changed to **VDIFF**. The original **VCOMP** setting will be retained upon switching back to **VCOMP** unless the PVG setting is changed while in **VDIFF** mode.

PVG oven The 1855A oven regulates over a wider ambient temperature range of approximately 0 to 50 deg C.

PVG AUTO ZERO The PVG AUTO ZERO function operates when PVG **ZERO** is pressed and whenever 0.0000 is displayed if the output exceeds 500uV. During warm-up, this results in frequent PVG autozero operation and may cause the 1855A to seem unresponsive to other commands. Setting the PVG to any voltage other than 0.0000 will restore normal response.

The 1855A also performs its autozero routine whenever the X1 or X10 GAIN button is pushed. During this time the PVG output is momentarily set to 0.

PVG absolute mode 1855 PVG increment and decrement buttons always function to increment or decrement the *display* respectively. When decrementing from a positive voltage, the display always stops at zero. To obtain negative voltages, the ± button must be pushed, and the increment button is used to increase the magnitude of the negative voltage. This operation is natural if simply setting a voltage, but unnatural if moving an oscilloscope trace. This is known as the PVG absolute mode. The 1855A provides the option of operating in this same manner.

PVG roll through zero mode The 1855A increment buttons are trace related by factory default. The increment buttons move an oscilloscope trace upward and the decrement buttons move the trace downward independent of the PVG polarity. Decrements from a positive voltage will roll smoothly through zero. For example, if the PVG is set to +1.0500 and the decrement 1V button is pushed, the PVG output will change by -1.0V to -.95V. If however the display actually reads 0.0000 during this process, the PVG AUTO ZERO will be implemented, the display will pause briefly at 0.0000 and the voltage will then continue to increase in a negative direction. This is known as roll through zero mode.

Toggle PVG modes To change from roll through zero to absolute mode of operation hold the PVG ZERO button and press the ± button. Change back to the roll through zero mode by repeating the same operation.

Reset to factory default The instrument can be set to factory default mode by pressing the **VCOMP** and **VDIFF** buttons simultaneously. Factory defaults are as follows:

GAIN	X1
ATTN	÷10
+INPUT COUPLING	OFF
-INPUT COUPLING	OFF
BW LIMIT	FULL
PVG	+00.000
VCOMP	OFF
VDIFF	OFF
INPUT RESISTANCE	1M
PVG mode	roll through zero

Standby mode Early 1850 and 1855 units supplied power to the PVG oven when the rear panel **STANDBY** push button switch was **OFF**. All 1850 and 1855 units which used a rocker switch were turned on or off entirely by the switch.

The 1850A and 1855A do not supply power to the oven when the power switch is off.

OSCILLOSCOPE SETTINGS

The Preamble Instruments 1850A/1855A output is intended to connect directly to the input of an oscilloscope, spectrum analyzer, network analyzer, or digitizer, but it is important to observe some rules so that the 1850A/1855A delivers its specified performance.

INPUT IMPEDANCE

The 1850A/1855A output impedance is 50 ohms and the intended load impedance is also 50 ohms. Nominal gain (amplification) is obtained only when the oscilloscope, (network analyzer, etc) input impedance is set to 50 ohms. The **EFFECTIVE GAIN** lights and **the PRECISION VOLTAGE GENERATOR** display are correct only when the 1855A is properly terminated into 50 ohms.

A factor of two additional gain is achieved by setting the oscilloscope input impedance to 1 megohm, but the **1MHz** and **20MHz** bandwidth limit filters will have poor transient response. This is because these passive filters are located directly at the 1855A output to afford maximum signal to noise ratio. Their response depends upon termination into a 50 ohm load. The effects of improper termination are especially visible with long cable lengths between the 1855A and the oscilloscope.

The **FULL** and **100kHz** bandwidth selections have 50 ohm output impedance over a wide bandwidth and will not cause transient response deterioration when connected to a 1 megohm load.

SENSITIVITY, POSITION AND OFFSET

Oscilloscopes are designed to maintain their accuracy for that portion of a signal that is displayed on-screen. When the signal is large enough to drive the display off-screen, the oscilloscope's amplifier must limit the signal in a non-linear mode. Oscilloscopes are designed so that no matter how the sensitivity, position and offset controls are set, the operator cannot view this distorted portion of the signal. How well the oscilloscope handles being overdriven is covered by its overdrive recovery specification, if any.

The maximum 1850A/1855A output is carefully controlled so it will not exceed ±500mV when the output is properly terminated into a 50 ohm load. This is most important when making measurements that require good overdrive performance, especially with those oscilloscopes exhibiting poor overdrive recovery performance.

The oscilloscope's gain and position controls should be properly set to avoid displaying the non-linear portion of the 1850A/1855A's output signal when it is in overdrive. This can be accomplished by observing the two following rules:

1. **Turn the oscilloscope input coupling to "OFF" or "GND", set the oscilloscope position control to center screen, and do not change it!** If the oscilloscope has an **OFFSET** control, it too should be set to zero. Return the oscilloscope's input coupling to "**DC**". Subsequently adjust the trace position on the oscilloscope screen using the 1855A PVG (an external source for the 1850A) and V_{DIFF} mode or V_{COMP} input. This assures that the oscilloscope is looking at the center of the 1850A/1855A's dynamic range.

2. **Set the oscilloscope deflection factor to no greater than 50mV/div.** The most useful range for the oscilloscope deflection factors will be between 1mV/div and 50mV/div. Using a deflection factor of 200mV/Div will bring the nonlinear portion of the 1850A/1855A's output on screen. Digitizers should not expect accurate measurements for high frequency signals from the 1850A/1855A exceeding ±250mV into a 50 ohm load. This is equivalent to ±5 divisions of deflection at 50mV/div in an oscilloscope.

More sensitive settings (*e.g.* 100µV/div) available on some oscilloscopes are perfectly acceptable, but their usefulness may be limited by noise, particularly with the 1850A/1855A **FULL** bandwidth limit selection and without averaging. With the oscilloscope set to 100µV/div and the 1850A/1855A in the **X10 GAIN** mode, the over all deflection factor will be 10µV/div.

In its **X10 GAIN** mode, the 1850A/1855A is somewhat quieter than oscilloscopes, so it is preferable to use the 1850A/1855A **X10 GAIN** mode and a lower oscilloscope deflection factor rather than the other way around. For example, to obtain the best noise performance at 1mV/div, set the 1850A/1855A to **X10** mode and the oscilloscope to 10mV/div rather than the use **X1** mode and 1mV/div. This also maximizes the bandwidth, as some oscilloscopes give up some bandwidth at their most sensitive settings. Other oscilloscopes give up bits of resolution to obtain 1mV or 2 mV/div sensitivity. The 1850A/1855A is very quiet in its **X10 GAIN** mode, but no better than most oscilloscopes in the **X1** mode.

Any oscilloscope bandwidth limit setting may be used so long as the unlimited signal does not exceed full screen before invoking bandwidth limit. This is a good rule to follow in using oscilloscopes with or without the 1850A/1855A.

MODEL 1850A OPERATION

The performance and operation of the 1850A Differential Amplifier is identical to that of the 1855A except as follows:

1. The 1855A three pole bandwidth limit filters are not included in the 1850A. The 1850A operator should rely on the bandwidth limit capabilities provided with the oscilloscope.

2. The 1855A **EFFECTIVE GAIN** indicator is not included in the 1850A. The 1850A operator will need to keep track of the various attenuator and gain settings to accurately account for the proper deflection factor on the oscilloscope.

3. The V_{COMP} and V_{DIFF} functions operate the same as in the 1855A. The 1850A does not contain the Precision Voltage Generator, but the voltages required for the operation of V_{COMP} and V_{DIFF} can be provided from an external source. This voltage source is applied to the 1850A through the **OFFSET VOLTAGE** connector on the rear panel. By using a stable voltage source and monitoring the level with a digital voltmeter (DVM), operation and accuracy similar to that of the 1855A can be achieved. The maximum input voltage that can be applied depends on whether the 1850A is operated in V_{COMP} or V_{DIFF} mode.

In the VCOMP mode, the maximum **OFFSET VOLTAGE** connector input is limited by the 1850A/1855A common mode dynamic range. In the VDIFF mode it is limited by the dynamic range of the internal VDIFF amplifier.

The following charts will help the operator stay within the maximum input voltage limits and understand the relationship between the actual voltage applied and the effective voltage. Effective voltage is always referred to the input of the 1850A or the probe tip if a probe is used. When using probes, the maximum effective voltage range may be limited by the maximum voltage rating of the probe.

When operating the 1850A with an external voltage source, the applied voltage should not exceed 15.5 volts in Comparison mode and 10.0 volts in Differential Offset mode.

Damage to the instrument can occur if greater than 20 volts is applied in the VDIFF mode.

When these maximum external voltages are applied, the effective voltage as seen by the amplifier is as follows:

FRONT PANEL SETTINGS		EFFECTIVE FULL SCALE RANGE	
GAIN	ATTEN	V_{COMP}	V_{DIFF}
X1	÷10	±155V	±100V
X10	÷10	±155V	±10V
X1	÷1	±15.5V	±10V
X10	÷1	±15.5V	±1V

NOTE

The effective voltage is always increased by the attenuator. It therefore follows that any probe will increase the effective voltage of both V_{COMP} and V_{DIFF} by its attenuation factor. In other words, a probe with a 100X attenuation factor will increase the effective full scale range by 100.

FRONT PANEL SETTINGS		EFFECTIVE FULL SCALE RANGE WITH 100X PROBE	
GAIN	ATTEN	V_{COMP}	V_{DIFF}
X1	÷10	±15.5kV	±10kV
X10	÷10	±15.5kV	±1000V
X1	÷1	±1550V	±1000V
X10	÷1	±1550V	±100V

Although the full scale range may be 10kV or 15.5kV, most probes have a much lower maximum input voltage rating which must not be exceeded.

SECTION 3
GENERAL OPERATING INFORMATION

GETTING STARTED

This section will help the first time user become familiar with the operation of the 1850A and 1855A and how it interfaces with an oscilloscope. Operation of the 1850A and 1855A is very similar except an external voltage source is needed for 1850A operation of the comparison and differential offset modes. "1850A/1855A" refers to either the 1850A or 1855A.

To carry out the following exercises, the operator will need an oscilloscope and a general purpose function generator.

POWER CONNECTION

Connect the power cord to an appropriate power source. The 1850A/1855A will operate on a 50 or 60Hz AC power source with a nominal voltage range from 100 volts to 250 volts. Turn the power on by depressing the rear panel **1** (on) portion of the rocker switch.

CONNECTING TO AND SETTING UP THE OSCILLOSCOPE (See page ii)

Connect a 50 ohm coaxial cable between the **AMPLIFIER OUTPUT** BNC on the 1850A/1855A rear panel and the oscilloscope's input connector. If the oscilloscope has 1 megohm and 50 ohm input capability, select 50 ohms. If the oscilloscope has only a one megohm input, terminate the coaxial cable at the oscilloscope's input with a 50 ohm feed-through terminator. It is important that the 1850A/1855A be terminated by 50 ohms.

Set the oscilloscope deflection factor to **50mV/div**. Set the oscilloscope's input coupling to **GND** or **OFF** and position the trace to center screen. **Do not move the oscilloscope position setting after this initial set-up**. Change the oscilloscope input coupling to **DC**.

1855A FRONT PANEL OPERATION

Change the power switch located on the 1850A/1855A's rear panel to **1** (on). The 1850 and 1855 will turn on in approximately 2 seconds.

All display indicators, including the red **OVERLOAD** light and all segments in the Precision Voltage Generator display will be lighted.

All controls except the Precision Voltage Generator (PVG) display will next change to the state in which they were left when the 1850A/1855A was last turned off. The PVG display will show model number and firmware version briefly. "1855.11" means model 1855A, firmware version 1.1. The PVG display will then return to the voltage set when the 1850A/1855A was last turned off.

During warm up, the 1855A may seem sluggish. Enter a "1" in the least significant digit of the PVG display to kept the microprocessor from constantly trying to autozero the PVG before the instrument's oven is up to temperature. The PVG output will have an offset of up to 40mV during this period. Before proceeding with the following exercise, allow the 1855A to warm up for at least 7 minutes. Press the PVG **ZERO** button before continuing.

ATTENUATOR AND GAIN OPERATION

Conduct the following exercise to familiarize yourself with the 1850A/1855A: Connect the function generator output to the **+INPUT** BNC connector and apply a sinewave of 50kHz and 0.5V peak amplitude. Push the **DC** button on the 1850A/1855A's **+INPUT**. The signal on the oscilloscope should be 2 divisions peak to peak in amplitude. Adjust the oscilloscope's sweep speed and trigger to display at least two complete cycles of the waveform.

Press the ÷1 **ATTENUATOR** button. The waveform's magnitude on the oscilloscope's display will increase by a factor of 10 and extend off the top and bottom of the screen. The **X1** light will be lighted in the **EFFECTIVE GAIN** display. Reduce the function generator's output until the oscilloscope's display is again 2 divisions peak to peak. The overall sensitivity of the 1855A and the oscilloscope is now 50mV/div.

Now press the **X10 GAIN** button. Observe the following changes: The **+INPUT**'s **DC** light will momentarily go out and its **OFF** light will be lighted before returning to their previous states. This momentary change is the result of the 1855A automatically adjusting its DC Balance (AUTO ZERO). The **X10** light will be lighted in the **EFFECTIVE GAIN** display and the display on the oscilloscope will again extend off screen. The overall sensitivity of the 1855A and the oscilloscope is now 5mV/div.

COMPARISON VOLTAGE OPERATION (VCOMP)

Leave the 1850A/1855A set up as in the previous exercise or set as follows:

+INPUT	**DC**
–INPUT	**OFF**
BW LIMIT	**FULL**
GAIN	**X10**
ATTENUATOR	**÷1**
INPUT RESISTANCE	**1M**
PVG	**+0.0000**
COMPARISON or **DIFFERENTIAL**	**COMPARISON**
EFFECTIVE GAIN	**X10**

• **Function Generator** output — 50kHz 50mVpk sine wave, connected to the 1850A/1855A's **+ INPUT.**

• **Oscilloscope** — Set at 50mV/div (equivalent to 5mV/div with 1855A at **X10 GAIN**) and sweep adjusted for 2 to 3 cycles.

Under these conditions, the display on the oscilloscope will extend off the top and bottom of the screen.

Press the **–INPUT**'s V_{COMP} button. This internally applies the Precision Voltage Generator's (PVG) output to the 1855A's **–INPUT** and the **OFF** light goes out (the **–INPUT** connector is disabled). For the 1850A, connect a variable external voltage source capable of -10V to +10V range to the rear panel BNC marked **OFFSET**.

Note that for the 1855A, the rear panel **OFFSET** connector is an output which monitors the PVG voltage. However, the 1850A **OFFSET** connector is an input accepting a range of -10V to +10V. Serious damage will result when the 1850A **OFFSET** connector is connected to more than ±20 volts.

The positive and negative peaks of the waveform displayed on the oscilloscope are (respectively) 10 divisions above and below the display center line. Push the button above the digit that is two places right of the decimal (10mV) in the Precision Voltage Generator (PVG) until the positive peak of the waveform appears in the oscilloscope's display. Continue incrementing and decrementing Precision Voltage Generator's digits until the peak of the waveform is at the center line of the oscilloscope's display. The number in the Precision Voltage Generator display is the waveform's positive peak voltage.

For the 1850A, manually adjust the external voltage source until the top of the waveform is at center line of the oscilloscope's display. Use a DVM to monitor the external voltage source. The voltage at the center line will equal the DVM reading.

The 1850A uses an **OFFSET** input range of only +15.5V to -15.5V (+10.0V to -10.0V in the V_{DIFF} mode). The offset is applied to the 1850A's internal amplifier's negative input directly rather than through the input attenuator. When the **ATTENUATOR** is set to **÷10** the effective offset is increased by a factor of 10. Thus it takes only 9.3V applied to the rear panel **OFFSET** connector to offset 93V applied to the **+INPUT** connector. Remember to apply this correction factor when setting the **ATTENUATOR** to ÷10. An attenuating probe has the same effect, so using a ÷100 probe increases the effective offset range from ±15.5V to ±1550V. Remember, however that while the effective offset is mathematically calculated in this fashion, many probes are not capable of 1550 volts offset. Limit the probe input to the voltage rating for the probe.

Press the ± button in the Precision Voltage Generator. Observe that the negative peak of the signal is now at or near the oscilloscope's display center line. By incrementing and decrementing the digits, the negative peak can be positioned to the oscilloscope's display center line. Now the number in the Precision Voltage Generator's display is the waveform's negative peak voltage.

Change the oscilloscope's sensitivity from 50mV/div to 10mV/div. Overall sensitivity, including the 1850A/1855A, is now 1mV/div. Temporarily change the oscilloscope's input coupling from DC to GND (or OFF) and re-center the trace to center screen using the oscilloscope's position control. Return its input coupling to DC. Now press the **X10** button on the 1850A/1855A to invoke its **AUTO ZERO** function. It is not necessary to disconnect the signal from the 1850A/1855A input to perform **AUTO ZERO**. The 1850A/1855A automatically performs this operation as part of the **AUTO ZERO** routine. (Note that pressing the gain button that is already selected causes the 1850A/1855A to adjust its DC balance (invoke **AUTO ZERO**), but does not change its gain.)

Change the Precision Voltage Generator's reading to again place the negative peak of the waveform at the oscilloscope's center screen. Note that the PVG (Precision Voltage Generator) display represents the negative peak voltage of the waveform with greater resolution.

The **GAIN** control affects the 1850A/1855A amplifier gain but does not affect the offset range. The 1855A PVG display reflects this fact. The 1850A effective offset calculation is not affected by the **GAIN** setting.

Return the oscilloscope's sensitivity to 50mV/div and press the 1855A's **–INPUT OFF** (or **AC** or **DC**) button. The PVG will retain its setting and the display on the oscilloscope will be centered about the center line. Press the **–INPUT**'s **V_{COMP}** button again and observe that the Precision Voltage Generator's output is again connected to the minus input of the 1855A's **–INPUT**.

Following are a few observations on using the 1855A comparison voltage mode (**V_{COMP}**):

1. The negative input and its **AC**, **OFF** and **DC** coupling are disabled. Instead of being a differential amplifier, the 1855A becomes a differential comparator. It compares the voltage present at the **+INPUT** with the output of the Precision Voltage Generator and when they are equal, the output of the 1855A is zero volts.

2. The value displayed by the Precision Voltage Generator indicates a waveform's voltage, with respect to ground, as it passes through the oscilloscope display's center line. It is very important that the oscilloscope's trace be positioned to center screen if an accurate measurement is to be made using this method.

3. By using the 1855A in the comparison voltage mode and the oscilloscope in a high sensitivity setting, highly accurate voltage measurements can be made.

4. The Precision Voltage Generator can be used as a position control which allows the 1855A to operate in its linear region.

DIFFERENTIAL OFFSET OPERATION (V_{COMP})

Leave the 1855A set up as in the previous exercise or set it up as follows:

+INPUT	**DC**
–INPUT	**V_{COMP}**
BW LIMIT	**FULL**
GAIN	**X10**
ATTENUATOR	**÷1**
INPUT RESISTANCE	**1M**
PRECISION VOLTAGE GENERATOR	**–0.0500***
COMPARISON or **DIFFERENTIAL**	**COMPARISON**
EFFECTIVE GAIN	**X10**

*approximate, and apply approximately -0.05V to the 1850A rear panel **OFFSET** connector.

- **Function Generator output** — 50kHz 50mVpk sine wave connected to the **+INPUT** of the 1850A/1855A.

- **Oscilloscope** — set at 50mV/div (equivalent to 5mV/div with 1850A/1855A at **X10 GAIN**) and sweep adjusted for 2 to 3 cycles.

- Externally trigger the oscilloscope on the function generator's output (same signal as is applied to the 1855A's **+INPUT**).

Under these conditions, the negative peak of the display on the oscilloscope should be very near center screen. Adjust the Precision Voltage Generator until the negative peak is at center screen. For the 1850A, adjust the external voltage source until the negative peak is at center screen.

Press the **V_{DIFF}** button. This internally applies the output of the Precision Voltage Generator to a point within the 1855A's amplifier that facilitates a true differential offset. Also note that the **–INPUT** coupling changed. The **V_{COMP}** light went out and the **OFF** light was lighted. In the line under the Precision Voltage Generator display (**COMPARISON** or **DIFFERENTIAL OFFSET**), the **COMPARISON** light went out and the **DIFFERENTIAL** light was lighted. This indicates that the Precision Voltage Generator will now be applied as a differential offset rather than as a comparison voltage as in the previous exercise. Both the **+INPUT** and the **–INPUT** inputs are now enabled, although the **-INPUT** is not in use at the moment.

Press the ± button in the Precision Voltage Generator. (With the 1850A, change the polarity of the external voltage source connected to the 1850A rear panel **OFFSET** connector.) Observe that the negative peak of the signal is now at or near the oscilloscope display's center line. By incrementing and decrementing the digits, the negative peak can be positioned to the oscilloscope display's center line. Now the number in the Precision Voltage Generator's display is the value of the waveform's negative peak voltage. With the 1850A, the reading of the DVM attached to the external voltage source will be the voltage at the oscilloscope center line.

Change the oscilloscope's sensitivity from 50mV/div to 10mV/div. Overall sensitivity, including the 1850A/1855A, is now 1mV/div. Temporarily change the oscilloscope's input coupling from **DC** to **GND** (or **OFF**) and re-center the trace to center screen using the oscilloscope's position control. Return its input coupling to **DC**. Now press the 1850A/1855A **X10** button to invoke its **AUTO ZERO** function. (Note that pressing the gain button that is already selected causes the 1850A/1855A to adjust its DC balance, *i.e.* invoke **AUTO ZERO,** but does not change its gain.)

Change the PVG (or external source in the 1850A case) to again place the negative peak of the waveform at the oscilloscope's center line. Note that the Precision Voltage Generator's display more accurately represents the negative peak voltage of the waveform.

Return the oscilloscope's sensitivity to 50mV/div and again press the 1850A/1855A's V_{DIFF} button. The V_{DIFF} light will extinguish and the oscilloscope display will be centered about the center line. Notice that the 1855A PVG retains its setting, but the output of the PVG is not applied to the amplifier. Press the V_{DIFF} button again and observe that the PVG's output is reapplied internally to the 1855A amplifier.

Following are a few observations on using the differential offset mode(V_{DIFF}) of the 1850A/1855A:

1. Both the positive and negative inputs (**AC**, **OFF** and **DC**) are enabled and the 1850A/1855A remains a true differential amplifier.

2. The value displayed by the Precision Voltage Generator indicates a waveform's differential voltage, with respect to the **–INPUT**, as it passes through the oscilloscope display's center line. It is very important that the oscilloscope's trace be positioned to center screen if an accurate measurement is to be made using this method. The voltage applied to the 1850A's **OFFSET VOLTAGE** input also indicates the waveform's differential voltage with respect to its **–INPUT**.

3. By using the 1855A in the differential offset mode and the oscilloscope in a high sensitivity setting, high resolution voltage measurements can be made. The **–INPUT** is the reference for these measurements.

4. The PVG can be used as a position control which allows the 1855A to operate in its most linear region.

5. The PVG will retain its voltage when switching between VCOMP and VDIFF if the voltage is less than 10.0 volts in magnitude, the maximum allowed for **VDIFF**.

WHICH OFFSET MODE SHOULD BE USED?

The operations of the Comparison (V_{COMP}) and Differential Offset modes (V_{DIFF}) are quite similar. The Comparison mode is easier to understand and has a wider range, 15.5 volts vs 10.0 volts. The Differential Offset mode provides offset operation while allowing the 1855A to function as a true differential amplifier.

For most applications, the Differential Offset (V_{DIFF}) mode has advantages over the Comparison (V_{COMP}) mode. When using the Comparison mode, the Precision Voltage Generator's output is subtracted from the **+INPUT**. Except for the PVG's offset, operation is the same as a standard single-ended oscilloscope...only one 1850A/1855A input is available. In the Differential Offset mode, the 1850A/1855A functions as a differential amplifier...both **+INPUT** and **–INPUT** function. This allows the operator to choose a measurement reference point other than ground. Even in ground referenced measurements, signal degradation can be reduced by using the **–INPUT** probe to select a ground reference point with the least noise. This method is especially useful in eliminating hum and noise from ground loops.

There is one instance in which the Differential Offset (V_{DIFF}) mode might result in more noise. Magnetic pick-up is proportional to the area between the probes. If twisting the probe leads together is not sufficient to reduce magnetic pick-up, the Comparison Offset (V_{COMP}) mode may be preferable.

Because the Comparison Offset mode uses the CMRR of the 1850A/1855A while the Differential Offset mode uses an internal amplifier, the Comparison Offset mode is slightly more accurate.

The Differential Offset (V_{DIFF}) mode is usually the mode of choice if the wider range or higher accuracy of the Comparison (V_{COMP}) mode is not needed.

OPERATOR TRAPS TO AVOID

There are a few situations the operator of either the 1850A or 1855A should be aware of to avoid some potential measurement traps.

EXCEEDING COMMON MODE RANGE

The 1850A and 1855A Differential Amplifiers have the largest common mode range available for this type of amplifier and are very good at measuring small differences between two large signals. However, care still must be taken not to allow a large common mode signal to exceed the available common mode range.

The maximum common mode range is ±15.5 volts when a signal is applied directly (÷1 **ATTENUATOR** and no probes) to the 1850A/1855A's + and **–INPUTS**.

Attenuating the input signal extends the common mode range by the same factor as the attenuation. Pressing the ÷10 **ATTENUATOR** button increases the common mode range to ±155 volts, and using a probe with a ÷10 attenuation factor will too. The effect of the internal ÷**10 ATTENUATOR** and the attenuation factor of probes is multiplied just as the signal is attenuated. For example, using the amplifier's ÷**10 ATTENUATOR** with a probe having a ÷100 attenuation factor (total attenuation of ÷1000) results in a common mode range of 15,500 volts. In this case, the probe's maximum voltage rating probably limits the maximum common mode input voltage.

The gain setting of the amplifier has no effect on common mode range; it is the same in **X10 GAIN** as it is in **X1**.

When making measurements on circuits that are line referenced, use enough total attenuation to keep the peak voltage at the amplifier input below 15.5 volts. **The US power-line can exceed 170 peak volts and therefore at least a total attenuation of ÷100 should be used.** Line voltages in some other countries are larger but their peak voltages do not exceed the 1550 volt common mode range that a ÷100 attenuation factor provides.

MOVING THE OSCILLOSCOPE POSITION SETTING AWAY FROM CENTER SCREEN

When operating the 1850A/1855A with a scope, it is very important to set the oscilloscope's position and/or offset control to center screen. There are a couple of reasons for this.

First, the linear portion of the 1850A/1855A's ±500mV output range is centered around zero volts. As the 1850A/1855A approaches its limits, the output signal will be distorted. **Moving the oscilloscope's position control way from center screen can allow these distortions to appear on the oscilloscope's screen where they may be mistaken for part of the displayed signal.**

Second, proper operation of the 1855A's Precision Voltage Generator (PVG) depends on the operator knowing the location of zero volts on the display. The readout in the PVG is designed to display the voltage of the signal as it crosses the center line of the oscilloscope screen. If the oscilloscope's position or offset control has been moved, incorrect readings could result.

When the 1855A is controlled with the ProBus interface (using the **REMOTE** connector on the 1850A/1855A rear panel), the offset control on the oscilloscope controls the 1855A PVG. The PVG display will read the offset set from the oscilloscope front panel.

When the 1850A is controlled with the ProBus interface, an external source must be used to control the vertical trace position:

USING SCOPE AT GREATER THAN 50mV/div (*e.g.* 200mV/div)

"I know the input to the 1850A/1855A is a sinewave, but I am seeing a squarewave on the oscilloscope." This comment is the result of the operator setting the oscilloscope sensitivity to something less than 50mV/div. If the oscilloscope sensitivity is set to 200mV/div, the 1850A/1855A will limit at 2½ divisions above and below center screen (zero volt point if the oscilloscope's position control is properly set). Thus, a sinewave large enough to overdrive the 1850A/1855A will appear as a squarewave on the oscilloscope.

The 1850A/1855A is designed to cleanly limit the output signal to ±500mV. The 1850A/1855A is designed to recover very quickly once its input signal level decreases sufficiently to allow the amplifier to return to its linear range. The 1850A/1855A will recover from overdrive to its full accuracy much more quickly than most oscilloscopes.

If the 1850A/1855A did not limit the signal at ±500mV, it would be of no help to the oscilloscope in viewing large signals.

Keeping the oscilloscope's position at center screen and using oscilloscope sensitivities between 50mV/div and 1mV/div (or the oscilloscope's most sensitive setting) will insure good signal integrity. **When the displayed signal contains mostly low frequency components, the operator can use the oscilloscope's 100mV/div setting to allow large signals to be completely shown on screen.**

FAILURE TO TERMINATE THE AMPLIFIER IN 50 OHMS

"All the signals displayed on my oscilloscope seem to be twice as large as they should be." This comment results from not having the output of the 1850A/1855A properly terminated into 50 ohms. The 1850A/1855A output impedance is 50 ohms. The cable connecting the 1850A/1855A to the oscilloscope or spectrum analyzer should be 50 ohms and be terminated with a 50 ohm load. If the termination at the end of the connecting coaxial cable is missing, the amplifier will not be properly terminated. Several things occur if the external termination is missing.

First, the output isn't properly terminated for all frequencies resulting in poor frequency and transient response. For most signals this distortion will be minor, except when the 1855A's **1 MHz** and **20 MHz** bandwidth limit filters are used. These filters will ring when not properly terminated.

Failure to use a 50 ohm coaxial cable will adversely affect the transient response of the 20MHz filter even though the termination impedance is 50 ohms.

Second, the gain of the amplifier will be twice that indicated by the front panel settings. The 1855A's **EFFECTIVE GAIN** indicator will be off by a factor of two.

In some measurements, the operator can take advantage of this increased gain if the problems caused by not terminating the output are fully understood and taken into account.

The 1850A/1855A maximum output is limited to ±1.0V when the output is terminated with 1 megohm.

WARRANTY

Preamble Instruments warrants the products it manufactures and sells to be free of defects in materials and workmanship for a period of three years, (one year for passive probes and probe accessories). Preamble Instruments will repair or replace, at its option, any product which proves defective within the warranty period.

To obtain warranty service, the customer must contact Preamble Instruments within the warranty period to obtain a Return Material Authorization. The customer shall be responsible for the proper packaging, insurance and shipping charges for the return of the product to Preamble Instruments. Preamble Instruments will pay the shipping charges for the return of the product to the customer.

This warranty does not apply to damage resulting from the improper use or abuse of the product. The warranty also excludes any damage resulting from repair or modifications of the product which were not performed by Preamble Instruments or its authorized service facility.

This warranty is exclusive and no other warranty shall be made by Preamble Instruments or its representatives, express or implied. Preamble Instruments disclaims any implied warranty of fitness for use. Preamble Instruments' sole responsibility under the foregoing conditions of this warranty is the repair or replacement of products. Preamble Instruments and its representatives will not be liable for any special, indirect, incidental, or consequential damages resulting from the use of this product.

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