



# DA1-150-10-E: Series of Narrowband or Wideband Distribution Amplifiers



## Key Features

- Dual A and B inputs. Automatic or manual switchover, configured by the Ethernet port.
- 1-150 MHz wideband operation. Other band frequencies from 100 kHz to 200 MHz are available
- AGC Level Controlled. Output level remains stable to 0.1 dB even if input varies
- AGC can be disabled if required. Amplifier then has fixed gain. Different gains can be made upon request
- 5 - 40 sine outputs. Each output can be independently set to 0 dBm to > +10 dBm (options up to +20 dBm)
- Alarm monitoring. Input, all outputs and power supplies have alarm monitoring. Indication by front panel LEDs or Ethernet. Plus there is an overall alarm on the rear panel (DC voltage level).
- Ultra low phase noise. Typically -135 dBc @ 1 Hz offset. Floor Noise to -172 dBc/Hz is available.
- Excellent Allan Deviation. Typically  $<4 \times 10^{-14}$  at 1 sec,  $2 \times 10^{-17}$  at longer time intervals.
- > 100 dB channel isolation and > 140 dB reverse isolation. Protects reference input and prevents cross-talk.
- BNC Connectors standard. SMA or TNC or N type connectors optionally available.
- Ethernet interface for alarm monitoring and unit configuration.
- Dual AC Power Supplies as standard with automatic switchover in the event one supply fails.
- Optional Redundancy (two units with automatic switchover)
- Many other options and customized options. Bespoke design service available.

## General Description

The DA1-150-10-E series are a series of ultra-low noise distribution amplifiers. They cover 1-150 MHz (optional to over 200 MHz) either in a wideband unit (e.g. 1 -150 MHz), or narrowband versions (e.g. 5 MHz, 10 MHz). They can be used to synchronize from five to forty instruments to a frequency reference input. The reference input will typically be an OXCO, Rubidium, Cesium or Hydrogen Maser Frequency Standard.

The DA1-150-10-E has features not found in any competitive unit. This makes the DA1-150-10-E the industry's leading distribution amplifier. The DA1-150-10-E has outstanding low phase noise. Therefore, the DA1-150-10-E will not add any appreciable noise to the reference input. Phase noise is typically  $<-140$  dBc @ 1 Hz. This low phase noise enables units to be cascaded for over 1000 outputs.

## Amplifier with Gain and Automatic Gain Control (AGC)

Unlike most competitive units, the DA1-150-10-E accepts input levels from +7 dBm to +19 dBm. The output will not vary with input variations. Also options exist to change this input level range to values from -20 dBm to +30 dBm. Sinewave outputs are adjustable from 0 dBm to > +10 dBm (up to +20 dBm is available as an option). This AGC function is very useful when long cable runs are being used or equipment has different input level requirements. The AGC can be disabled if required, making the unit a fixed gain amplifier. Note that the AGC range may be different when other options are installed. Contact the manufacturer for further details on different configurations.

## Outputs

There are five to forty sinewave outputs depending upon what option is ordered. Each output is completely isolated from the input and each other. Therefore, the reference oscillator connected to the DA1-150-10-E's input is protected against load variations, short circuits etc. that may be applied to the outputs.

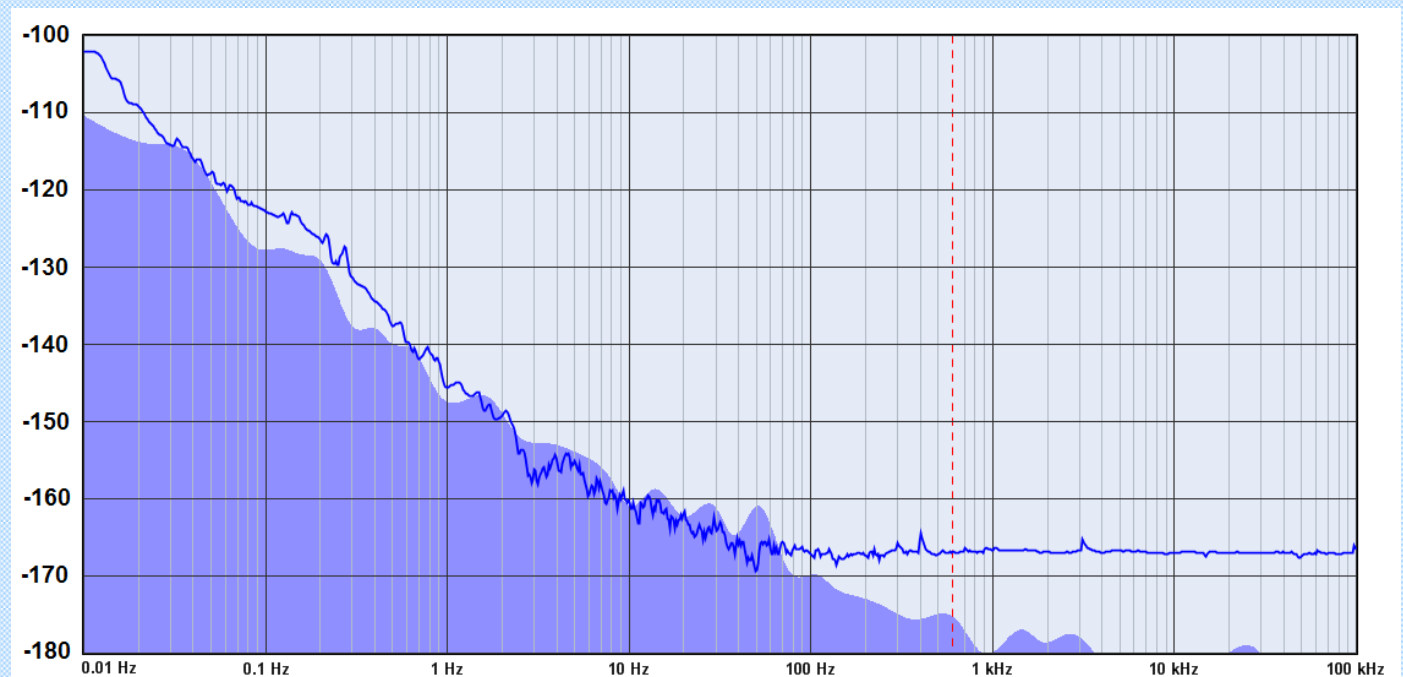
Channel to channel isolation is > 90 dB @ 10 MHz. Output to input isolation (reverse isolation) is > 130 dB @ 10 MHz

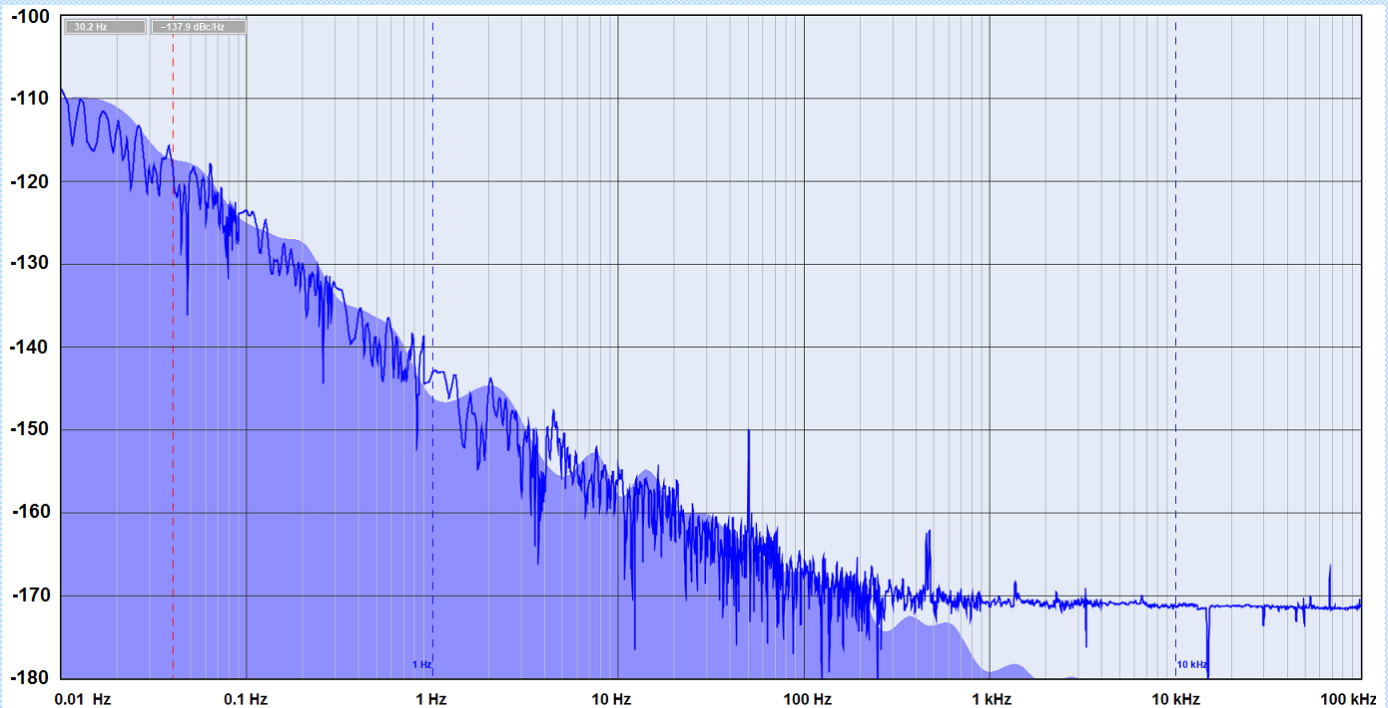
Each output port can be independently set to any level from 0 to > +10 dBm on the standard unit and outputs to +20 dBm are optional available. The ability to set every output to a different level is very useful when dealing with equipment that has different input level ranges. This is a unique feature of the DA1-150-10-E not found on any other unit.

## Phase Noise

The DA1-150-10-E has very low phase noise and Allan deviation. This enables units to be connected in series without adding any appreciable noise to the reference input. Up to 1000 outputs can be derived from one input using multiple amplifiers, without the need of cascading more than three amplifiers at a time. This keeps the phase noise to a minimum.

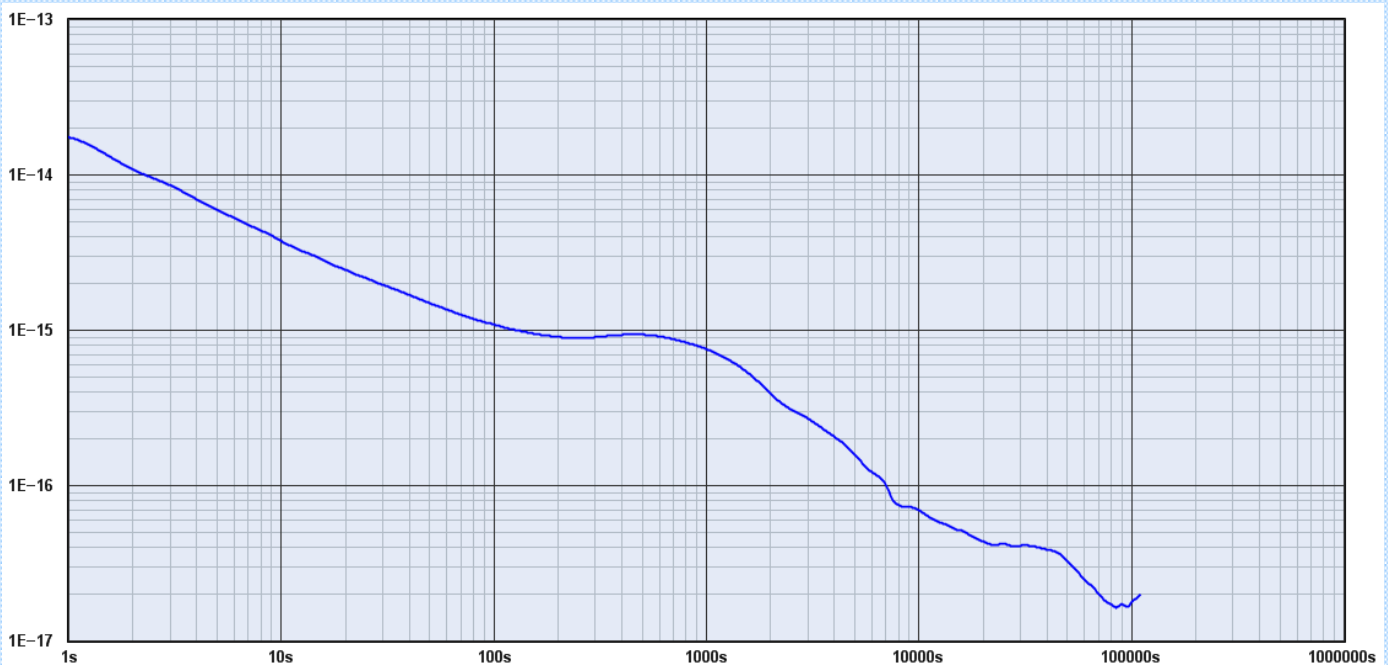
Two typical plots of phase noise at 10 MHz are shown below. The first plot is for an amplifier with 3 dB gain and AGC. The second plot for a unit with 0 dB fixed gain (no AGC). Note that phase noise may vary when other options are installed. Contact the manufacturer on expected phase noise for different configurations.





**Allan Deviation Plot**

The plot below shows the Allan deviation plot of the DA1-150-10-E. Allan Deviation is typically  $< 2 \times 10^{-14}$  for  $\tau = 1$  second with the noise floor less than  $2 \times 10^{-17}$ .



**Phase Stable with matched outputs**

The wide frequency bandwidth allows the outputs to have stable phase. The phase stability is typically  $5 \text{ ps}/^\circ\text{C}$ . Also the delay match between outputs is better than 2.5 ns overall and typically less than 500 ps between groups of five outputs.

## **Alarms**

There are alarms for the input, every output and power supplies. Should the RF level drop on the input or any output, an alarm will be raised. Front panel LED's show the status of the alarms including individual outputs. The status of any alarm can also be queried via the Ethernet interface. Additionally an overall alarm signal is available on the rear panel as a DC level output.

## **Ethernet Interface**

The Ethernet interface allows the unit to be configured as well as monitoring all alarms. An embedded web page allows the status of the amplifier to be monitored. Also, firmware updates are made using the Ethernet interface. Telnet protocols are also optional available.

## **Dual A and B Inputs**

The DA1-150-10-E has two reference frequency inputs, A and B. They can be configured, via the Ethernet port, so either A or B is the master with the other as the slave. In the event that the master input falls below a factory set limit, the slave will be automatically switched in with minimum glitch in the outputs. Alternatively the inputs can be set to manual mode where their operation is set by the Ethernet interface. Front panel LEDS show the status of the inputs.

## **Dual AC Power Supplies**

Two independent AC power supplies with separate AC connectors are incorporated. If one AC input or power supply fails, the second power supply will continue to operate the unit with no glitch in output. Front panel LEDS show the status of each power supply. The Ethernet port can also be used to query the power supplies status.

## **Applications**

The DA1-150-10-E Distribution Amplifier is ideal for use in calibration or standard laboratories, space research, satellite systems, communication systems or anywhere where ultimate performance is needed.

## **Miscellaneous Information**

The DA1-150-10-E is a highly reliable unit. The DA1-150-10-E is housed in a fully screened 19" rack mount case and operates from a 100 to 240 VAC supply (usable 90 to 260 VAC). The DA1-150-10-E is CE marked for sale within the EEC. It is guaranteed for three years.

## **Options and Other Amplifiers available from Precision Test Systems**

- Fully DC isolated outputs. Useful in preventing ground loops on long cable runs.
- Squarewave outputs. Either at the same frequency as the input, or at different frequencies.
- Multiplied or divided outputs. E.g. 10 MHz, input with 5 MHz output. 10 MHz input with 100 MHz output. Any type of multiplication / division can be incorporated.
- High and Low pass filters. This reduces broadband noise and reduces the harmonic output.
- Guaranteed phase noise specifications. Measured phase noise specifications supplied with unit.
- Higher output levels, up to +20 dBm.
- Different amplifier gains allowing different input levels from -20 dBm to +30 dBm to be accommodated. Note: that phase noise specifications will vary when different amplifier gains are fitted. Consult manufacturer for further details.
- Additional outputs. Up to 15 outputs in a 1U case, or 40 outputs in a 2U case.
- External DC Power Input. The DA1-150-10-E can also have an external 12VDC input. This can be used to provide backup power. If AC power is lost, the DA1-150-10-E will immediately switch to the DC supply.
- Redundancy. Two units operate together. If one unit fails, the outputs are automatically switched to the secondary unit.
- Internal backup oscillator. This oscillator is automatically enabled should the input signals fail.



DA1-150-10-E Rear view

Precision Test Systems also manufactures the PTS50, DA1010 and DA1-100 series of distribution amplifiers. These models are lower cost alternatives to the DA1-150-10-E but still give very good performance.

### DA1-150-10-E SPECIFICATIONS FOR STANDARD UNIT \*

Specification Parameter	Specification	Comments
<b>Dual Reference Inputs (A and B)</b>		
Frequency	1-150 MHz	See model list below for actual frequencies
Bandwidth (2-100 MHz)	± 3 dB	± 5 dB from 1 – 150 MHz
Impedance / Input VSWR	50 Ω / < 1.5:1 @ 10 MHz	Typically < 1.35:1 @ 10 MHz
Input Level	+7 dBm to +19 dBm	AGC Controlled. +25 dBm damage level
Reference Input Switching	Either Input A or Input B is used	Automatic or manual switchover
Switching time from A to B or B to A	< 10 ms	Typical
<b>Sinewave Outputs</b>		
Output Waveform	Sinewave	50 Ω BNC Connector on rear panel
Output Frequency	Exactly the same as the input	
Output VSWR	< 1.2: 1 @ 10 MHz	
Output level (individually adjustable)	Adjustable 0 dBm to > +10 dBm	Outputs to +20 dBm optionally available
Output Level Stability	< 0.05 dB / °C	Typically < 0.02 dB / °C
Harmonic Distortion (wideband version)	-20 dBc	Typically -25dBc. Assumes input source's harmonics are -25 dBc or lower.
Harmonic Distortion (narrowband version)	-45 dBc	Typically -50dBc. Assumes input source's harmonics are -30 dBc or lower.
Spurious Outputs (> 500 kHz)	-125 dBc	Typical
Channel to Channel Isolation	> 100 dB @ 10 MHz	Typically, > 105 dB
Input to Output Isolation	> 140 dB @ 10 MHz	
Delay match between outputs (wideband version only)	< 2.5 ns (<500 ps / 5)	< 500 ps within group of 5 outputs
Temperature Stability of delay (wideband version only)	10 ps/°C	Typically 5 ps/°C
<b>Slave Output</b>		
Slave Output	Output derived from selected input	Level = input level - 7 dB.
<b>Allan Deviation (typical @ 10 MHz)</b>		
Allan Deviation	< 7 x 10 <sup>-14</sup> (1 sec)	< 5 x 10 <sup>-13</sup> at 0.1 sec. Floor < 3 x 10 <sup>-17</sup>
<b>Phase Noise (@ 10 MHz)</b>		
Phase Noise (@ offset frequency) with +7 dBm in and 10 to +13 dBm out	@ 1 -130 @10 -148 @100 -157 @1k -163 @10k -165 @100k -165	This is for a unit with ten outputs and a gain of 6 dB. These are typical results
Phase Noise (@ offset frequency) with +13 dBm input and +13 dBm output	@ 1 -140 @10 -157 @100 -166 @1k -170 @10k -171 @100k -171	This is for a unit with five outputs and a gain of 0 dB. These are typical results
<b>General</b>		
Power (AC) Dual	100 - 240 VAC (usable 90 - 260)	

Specification Parameter	Specification	Comments
Power Input Frequency	47 Hz to 63 Hz	
Power Consumption	50 Watts maximum	For a standard unit.
Size and weight (5 to 15 outputs)	483 x 300 x 44 mm and 3.2 kg	Width x Depth x Height
Size and weight (16 to 40 outputs)	483 x 300 x 88 mm and 3.8 kg	Width x Depth x Height
Operating Temperature	-10 to +50 °C	Humidity < 90% non-condensing
Storage Temperature	-20 to +80 °C	Humidity < 90% non-condensing
Alarm Output	Alarm Outputs via DB-15 connector and Ethernet port.	Overall alarm DC output on DB-15 connector. High = No Alarm.
MTBF (estimate)	500,000 hours	Based on real data of similar products
<b>Ethernet Interface</b>		
Connector	RJ45	On rear panel
Speed	10/100 Mbps	
Ethernet Control / Protocols	Embedded web page	Telnet with option 27
<b>Options (not all options can be fitted at the same time, consult manufacturer)</b>		
Option 01	Dual changeover alarm relay	Activated in the event of an alarm
Option 02A / B	Ground Isolated Input / Outputs	
Option 03	Redundancy	Requires two units
Option 04 / 05 / 05B	TNC / SMA/ N type connectors	Replaces standard BNC connectors
Option 06	Guaranteed Phase Noise	Plots supplied with unit
Option 07	UKAS traceable certificate	
Option 08 with an additional letter Option 08A	Increased Output levels. +13 dBm o/p for +7 to +19 dBm i/p	Various options to +20 dBm available
Option 09 Option 09A to Option 09G	Additional five sinewave outputs Additional sinewave outputs (>5)	15 o/p's in all in 1 U case. Consult PTS for further details
Option 10	Squarewave outputs	TTL/CMOS or ECL output levels
Option 11	Divided frequency output	E.g. 2.048 MHz, 1MHz, 10 MHz, 1 pps
Option 12	Multiplied output	E.g. X2, X5, X10, X100.
Option 13 with an additional letter	Special narrow band version	State centre frequency and bandwidth
Option 14	External DC input	Nominal 12V external DC.
Option 16-XXX	Internal backup oscillator	XXX = frequency in MHz.
Option 17-XXX	Different Gain Levels	Customer to advise gain requirement
Option 18	Delete five outputs	Negative option. Reduces price.
Option 20	2 <sup>nd</sup> Input	Each input feeds five outputs
Option 22	Additional internal amplifier	Increases sensitivity to -20 dBm
Option 26 / 26B	Fiber optic input and outputs	
Option 27	Telnet protocols on Ethernet port	

\* Specifications only valid for the DA1-150-10-E. Some specifications may vary with installed options. Consult Precision Test Systems for further details.

**DA1-150-10-E series. Model numbering:**

DA1-150-10-E:	Wideband 1 – 150 MHz	DA1-150-10-E-10MHz:	Narrowband 10 MHz
DA1-150-10-E-100kHz:	Narrowband 100 kHz	DA1-150-10-E-13MHz:	Narrowband 13 MHz
DA1-150-10-E-1MHz:	Narrowband 1MHz	DA1-150-10-E-15MHz:	Narrowband 15 MHz
DA1-150-10-E-2048 kHz:	Narrowband 2048 kHz	DA1-150-10-E-150MHz:	Narrowband 150 MHz
DA1-150-10-E-5MHz:	Narrowband 5 MHz	DA1-150-10-E-160MHz:	Narrowband 160 MHz

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