High Input Analog Bandwidth Track and Hold Amplifiers

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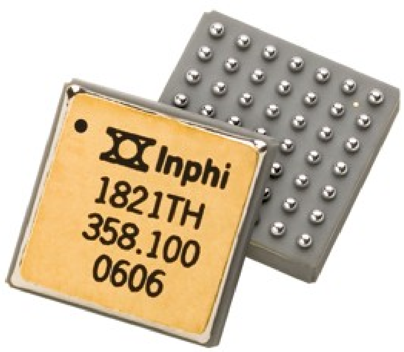
A new class of very high input analog bandwidth and high sampling rate track and hold amplifiers (THAs) has been developed for the test and measurement, Automatic Test Equipment (ARE), digital receivers, and radar systems using a commercially available Indium Phosphide (InP) technology. The newly developed THAs achieved an analog input bandwidth of 12 GHz at 1-Vpp input and a sampling rate as high as 2 GS/s. Figure 1 shows a photograph of the THA in a ceramic BGA package.



Inphi track and hold amplifier (model 1821TH)

InP technology is the fastest semiconductor technology in production today. Because of this inherent advantage, circuits made in InP typically outperform those made in traditional Gallium Asernide (GaAs) and Silicon Germanium (SiGe) for high-speed applications. InP technology is also a cost effective solution for circuits with reasonably complexity up to about 5,000 transistors, competing very well with GaAs and SiGe technologies for high-speed front-end applications. Inphi Corporation, for example, has shipped InP circuits in high volume since 2002, and continues to develop advanced InP products to meet the ever-increasing demands for high performance integrated circuit solutions.

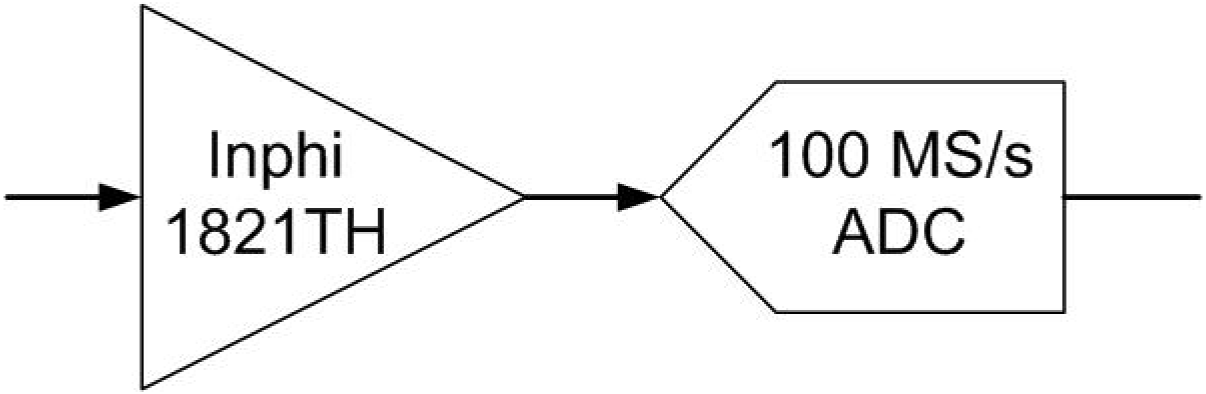
Track and hold amplifiers are often used as the high-speed front-end of an Analog-to-Digital Converter (ADC). The THA's primary function is to track the input signal and hold its voltage constant during the interval required for the ADC to perform the analog to digital conversion. By using a high performance THA as the front end of a low cost commercially available ADC, system designers can extend the input analog bandwidth of the ADC from MHZ to GHz frequencies. The resulting circuit offers a significant cost advantage over alternative approaches such as diode bridges and mixers.

High input analog bandwidth, high sampling rate, and low harmonic distortions are key parameters for THAs. Existing THAs are made in GaAs and more recently SiGe technology. These devices typically have an input analog bandwidth of 4 to 6 GHz. Figure 2 compares the performance of an InP THA (Inphi model 1821TH) against competing products in GaAs and SiGe. The InP THA offers a 12 GHz input analog bandwidth at full swing, 1-Vpp, which is the highest value for any commercial-off-the-shelf THAs today.

	Inphi InP 1821TH	**Competitor GaAs**	**Competitor SiGe**
Input analog bandwidth (small signal), GHz	18	9	N/A
Input analog bandwidth (1-Vpp), GHz	12	6	3.95
Single tone, Total Harmonic Distortion, 1-Vpp, 1 GHz, dB	-60	-59	-54
Single tone, Total Harmonic Distortion, 1-Vpp, 5 GHz, dB	-40	-25	N/A
Maximum sampling clock, GHz	2	1	3
Power Dissipation (W)	1.3	2.4	1.2

Comparison of GHz-class Track and Hold Amplifiers

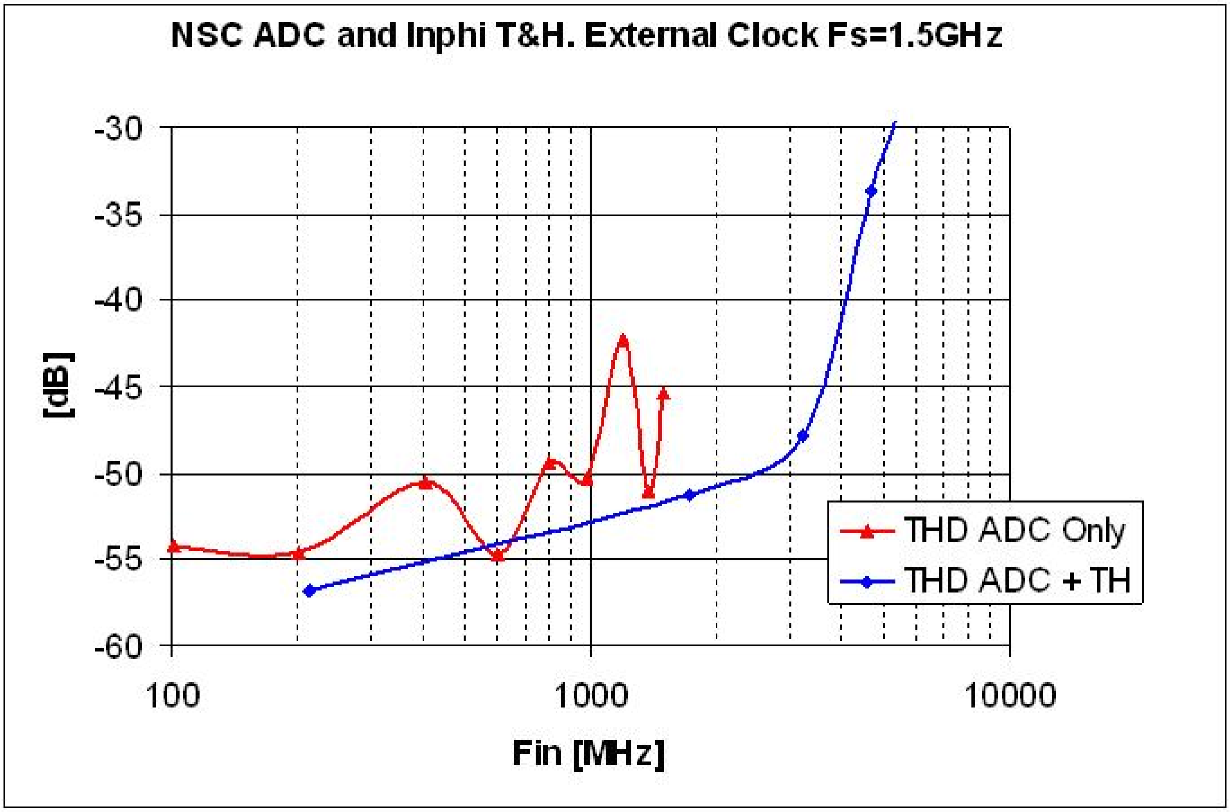
Because of the high input analog bandwidth of the InP THA, system designers now can extend the input analog bandwidth of the ADC from around 100 MHz to well over 12 GHz. Figure 3 depicts the block diagram of such a design, in which an InP THA is driving a commercial-off-the-shelf ADC with 100 MHz input analog bandwidth. The resulting circuit offers a significant cost advantage over alternative approaches and is now in mass production for high speed digital sampling scope and signal analyzer applications.



System block diagram of a 12 Gb/s digital sampling scope front end

Another popular application for high input analog bandwidth THAs is for automatic test equipment (ATE). For at speed testing, it is critical that the high speed signal be captured and digitized in real time. This application requires a very high speed ADC operating at multi-Giga samples per second. Such an ADC has recently become available commercially, but their input analog bandwidth is usually not high enough to capture the signal faithfully above 1 or 2 GHz. A high input analog bandwidth THA alleviates this issue, extending the bandwidth of the ADC while improving the overall performance of the system.

As an example, figure 4 compares the performance of a National Semiconductor high speed ADC (model ADC081500) with and without the InP THA at a 1.5 GHz sampling clock. Without the InP THA, the performance of the ADC began to degrade at input frequency above 1 GHz, whereas with the InP THA, the performance of the combined THA/ADC continued to be excellent up to about 3 GHz before experiencing significant distortion. Five to 10 dB improvements in single-tone total harmonic distortion were obtained with the InP THA “front end” over the entire frequency range from 100 MHz to 3 GHz.



Single-tone total harmonic distortion of the National Semi ADC (model ADC081500) with and without the Inphi THA (model 1821TH)

In summary, a new class of high input analog bandwidth, high sampling rate THAs is now available for test and measurement, automatic test equipment, digital receivers, and radar systems applications. These THAs offer system designers attractive solutions to directly capture and digitize high bandwidth signals at GHz frequencies, which result in higher performance, lower cost, smaller size, and lower weight systems.