Series DS

Fast Switching Synthesizers

Direct Synthesizers

Features

- Wide Bandwidth 0.010 to 40.96 GHz
- Very low phase noise -120 dBc/Hz typical at 10 kHz offset at 10 GHz
- Switching speed from 250 nanoseconds
- Step sizes from <1 Hz
- Low profile chassis or modular configuration
- Custom bands and step sizes
- Low spurious
- Parallel BCD programming
- Low power consumption, 100 watts from AC mains
- Coax strobe input and selection switch
- RF output mute
- High reliability
- Low sensitivity to microphonics
- Locks to external reference (10 & 100 MHz standard)
- Compact modular packaging as small as 10.6 X 9.5 X 3 inches
- Universal AC power supply

Options

- IEEE-488/GPIB, Ethernet
- Internal 100 MHz reference with sample output
- Phase Coherent switching
- Phase Continuous switching (bandwidth restricted)
- AM, PM, FM & Pulse Modulation
- Front panel control and display can be custom configured
- Touch Screen Computer (TSC) front panel for rack mount unit
- Digital frequency sweep via TSC
- FM with four operational modes; WBDC, WBAC, NBDC, NBAC
- Modulation bandwidth 10 MHz
- Expanded FM deviations
- Power flatness +/-1dB
- Coherent stepping to 1 Hz
- Downloadable list mode with fast list triggering and ready feedback signal
- Differential interface
- Linear AC power supply
- Binary control
- Harmonic filter banks.
- Switching speeds from 100 nanoseconds (Consult Factory)
- Noise floor -140 dBc/Hz @ 18 GHz

Description

Herley-CTI has served the military and commercial synthesizer market for over 30 years. Herley-CTI introduced a line of fast switching synthesizers based on three proprietary design concepts unique to the industry. As a result of these efforts Herley-CTI has fast switching synthesizers in service being used in diverse applications from EW simulators to ATE systems.

The series DS synthesizers are exceptionally quiet, fast, broadband and precise. Their phase noise rivals the best microwave fixed-frequency sources. With 250 nanosecond switching time, 500 nsec or less for coherent switching option, the DS delivers ample speed to meet the required response times of EW Simulator, Radar, RCS, ATE and Antenna measurement systems. In addition, the 1 Hz step size capability allows the frequency to be controlled to a high precision.

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Direct Synthesizers

Description cont'd

Custom versions are available with different step sizes and bandwidths. Parallel programming is standard in order to optimize speed. Other interfaces are available as options.

These direct synthesizers have been designed for low power consumption and high reliability. The complete DS synthesizer, with its combination of advanced performance features, is housed in a low profile 5.25" high rack- mountable chassis or optional 1.75" or 3.5" chassis for some models. For specialized applications the DS can be tailored to suit custom bands and physical outlines due to its modular architecture. The touch screen front panel version provides simple control and versatility.

The wideband DS synthesizer, because of its very low phase noise and fast switching, is a signal source with multiple uses in the test arena, including manual and automatic testing of wireless, radar, Satcom and digital radio equipment, as well as in high-performance frequency-agile surveillance, radar and communications equipment.

Our optional coherent switching synthesizer, unlike other technologies available, can perform coherent switching down to 1 Hz resolution over the full bandwidth of the synthesizer. Previous to this breakthrough coherent resolutions have been limited to larger steps because switching time performance degraded as resolution is decreased. The new design from H-CTI overcomes this limitation and provides a new tool for Signature Measurement Technologists.

This new synthesizer can be ordered with many options and can be custom configured to meet your requirements. As an example, an FM modulator can be added to the coherent unit to make it interchangeable between Simulator and Signature Measurement applications.

Typical Performance Specifications

Frequency Range	10 MHz to 20.48 GHz, Option to 40.96 GHz					
Custom Bandwidths	Any band within 10 MHz to 40.96 GHz					
Step Size	From 1 Hz standard					
Phase Noise (dBc/Hz) Output Frequency	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz
1 GHz	-110	-127	-138	-138	-146	-150
2 GHz	-104	-121	-132	-132	-140	-148
10 GHz	-90	-110	-120	-120	-130	-136
18 GHz	-84	-104	-114	-114	-124	-130
40 GHz	-77	-97	-107	-107	-117	-123
Power	+10 dBm +/- 2.5 dBm nominal					
Spurious (dBc)	Band		dBc			
	5,120 to 10,240 MHz:		-70			
	2,560 to 5,120 MHz		-75			
	1,280 to 2,560 MHz		-75			
	640 to 1,280 MHz		-75			
	320 to 640 MHz		-75			
	<320 MHz		-75			
	10,240 to 20,480 MHz		-65			
	20,480 to 40.960 MHz		-60			

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Typical Performance Specifications cont'd

Harmonics	<-15 dBc typ.; (-50 dBc optional)
External Reference	Unit can be configured to lock to an external 10 and / or 100 MHz reference.
Frequency Accuracy with Internal Ref.	+/-0.2 ppm over temperature; 1 ppm/year aging; Consult factory for other options
External Reference for Phase-Locking Internal Reference	External source accuracy +/- 1 ppm Power +3 +/-3 dBm
Freq. Accuracy with Ext. Ref.	Same as External Reference for Step sizes 250 kHz to 20 MHz Same as Ext. Ref. +/-1 x 10¯12 for Step size 1 Hz
Frequency Control	Parallel TTL BCD plus strobe standard; binary optional
Switching Speed	from 100 nanoseconds; tailored to your requirement
AC Power	47-400 Hz, 110/240 VAC auto switching 50-400 Hz, 110 or 240 VAC linear option
DC Supply Voltage (measured at synthesizer for DS modular configuration)	+10 Vdc, +6 Vdc, +15 Vdc, -12 Vdc
Ripple on DC (for DS modular configuration)	5 mVpp max 50 Hz to 50 kHz; 50 mVpp 50 kHz to 10 MHz when supplied by customer
Summary Alarm	TTL Low = Alarm (for DS modular configuration) or Alarm in red on TSC (for rack mount configuration)
Operating Temperature	0°C to +50°C standard; consult factory for extended ranges
RF Connectors/ Control Connectors	SMA female : RF Out and Ref In/Ref Out Standard 50 pin D-type for Frequency Control
Approximate Dimensions Rack Mount	1.75" x 16.75" x 22" or 3.50" x 16.75" x 22" 5.25" x 16.75" x 22" depending on options
Approximate Dimensions Modular configuration	10.63" x 9.5" x 4.5"
Approximate Weight	36 lbs (Rack mount), 17 lbs (Modular configuration)

FM Deviation Capability

Band (MHz)	+/- 1 V p-p into 50 Ohms Typical Deviation (MHz)	+/- 1 V p-p into 50 Ohms Expanded Deviation (MHz)
10 - 20	+/- 0.234375	N/A
20 - 40	+/- 0.4687	N/A
40 - 80	+/- 0.9375	N/A
60 - 160	+/- 1.875	N/A
160 - 320	+/- 3.75	N/A
320 - 640	+/- 7.5	Consult factory for down to 500 MHz
640 - 1280	+/- 15	Consult Factory
1280 - 2560	+/- 30	+/- 120 down to 2000 MHz
2560 - 5120	+/- 60	+/- 120
5120 - 10240	+/- 120	+/- 120
10240 - 20480	+/- 240	+/- 240
20480 - 40960	+/- 480	+/- 480

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Optional List Mode

List:	The operator may program a list of from 1 to 48000 random frequencies via an Ethernet, GPIB or HCTI custom interface. The frequencies in the list starting at address A and ending at address B can be swept from A to B, B to A or A to B and back to A. Minimum dwell time 10 microseconds typical.
Continuous Mode: Single or Auto	The unit will perform any of the sweep modes as discussed above, that were previously communicated over Ethernet, GPIB or HCTI custom interface. This mode is triggered by an external single start pulse. The unit will perform one sweep and stop, or will perform continuous sweeps until stopped by an Ethernet, GPIB or HCTI custom command. For this mode a previously loaded Dwell Time is required.
External Trigger:	Same as above but each step through the address list requires an external trigger pulse. No Dwell Time required as external pulses control Dwell Time. Lock Signal provided with each step.
Start, Stop, Step:	Via the Ethernet, GPIB or HCTI custom interface a Start address, Stop address. and Step Size is communicated. The unit starts operation at the start frequency and with each "Trigger In" pulse it will step with an increment of "Step Size"

Typical Touch Screen Computer Functions

- Frequency entry display
- Reference select
- Local / Parallel J1 / GPIB
- Frequency step up or down
- Alarm indicator
- Power on/off
- Sweep
  - Range
  - Direction
  - Dwell time
  - Trigger mode
  - Step size
  - Stop sweep
  - Resume sweep
- Ping-pong
  - Jump frequencies
  - Dwell time
  - Trigger mode
  - Stop ping-pong
  - Resume ping-pong

Note: All specifications subject to change without notice.

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Coherent DDS Module Switching Speed

- Blue Trace [1] = External Trigger into the Control Interface.
- Violet Trace [3]= FPGA trigger synchronous with latching the external control word into the DDS.
- Cyan Trace [2] = DDS output toggling between 2 frequencies.
- The vertical cursors measure the time from the input trigger to the frequency output change (132 nsec).
- Additional delays in the test setup include the output cable length (5 nsec) and the 100 MHz output LP filter (~9.5 nsec). Because the scope is triggered on the Red channel, the Blue channel shows the 10 nsec jitter due to the asynchronous timing of the input trigger.
- Figure 1 shows the switching time of the coherent DDS module from external trigger to be 132 nsec. The overall worst case switching speed of the complete Coherent switching DS synthesizer which includes this DDS is 500 nsec or less.

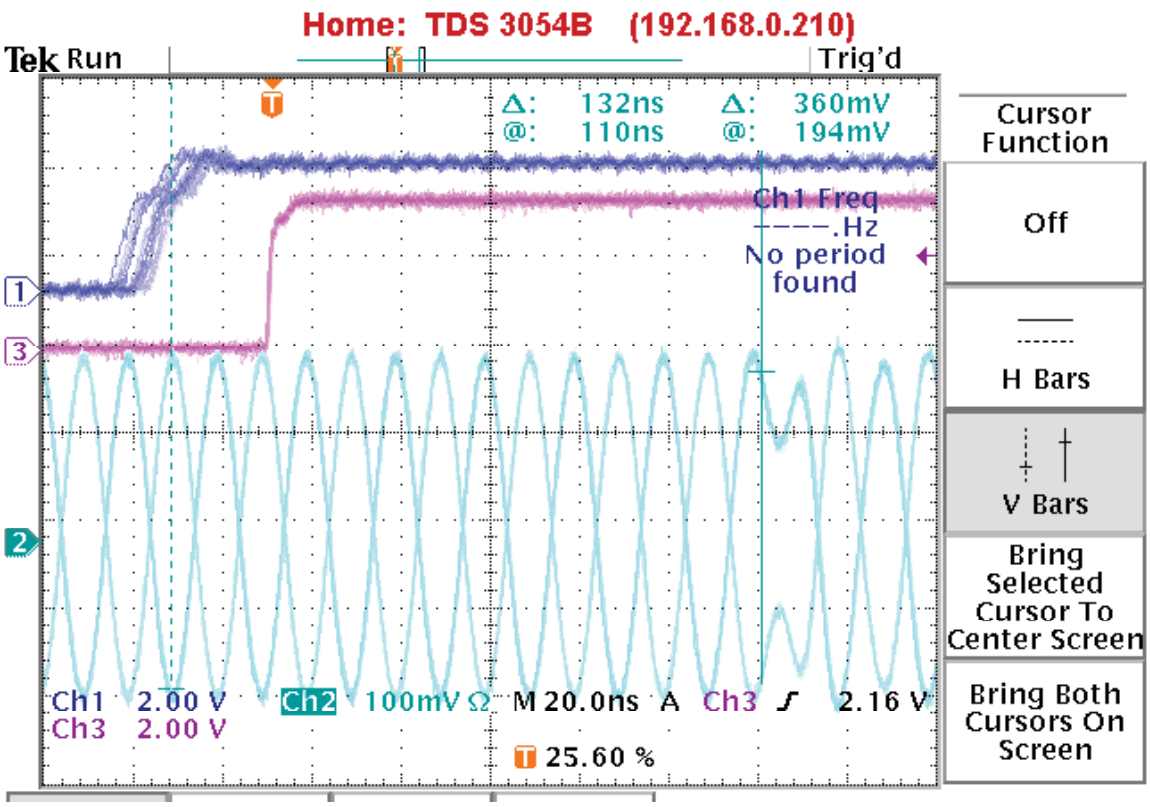

Figure 1

Note: All specifications subject to change without notice.

Coherent DDS Module Coherency Demonstration

The first test consists of two DDS units one running constantly at 50 MHz the other switched between 50 MHz and 50 MHz plus 1 LSB. These two DDS units are mixed, low passed filtered, and applied to the scope from which the pictures are taken. Figures 2 and 3 depict the unit being switched from a slightly higher frequency to 50 MHz, note the mixer goes to a DC level representing the phase between the two units. Please note this DC level, no matter how many times the signal is switched from 50 MHz to 50 MHz plus 1 LSB and back to 50 MHz, it always returns to the same DC level indicating it comes back at the phase that the constant 50 MHz signal is running at.

2-Tone Test Externally Triggered

- Violet Trace [3] = Internally generated trigger resulting from the external asynchronous trigger
- Cyan Trace [2] =Phase detector output.
- The 2-Tone Test build toggles between two frequencies: 50 MHz and 50 MHz + 1 LSB.
- The LO for the phase detector is provided by a second DDS module operating at 50 MHz and connected to the same 400 MHz clock.
- The output of the mixer is connected to the scope through a 10.7 MHz LPF. The "ringing" seen after the frequency change is a result of the filter.
- Figure 2 shows the frequency changing from 50 MHz + 1LSB to 50 MHz.
- Figure 3 shows the frequency changing from 50 MHz to 50 MHz + 1LSB.

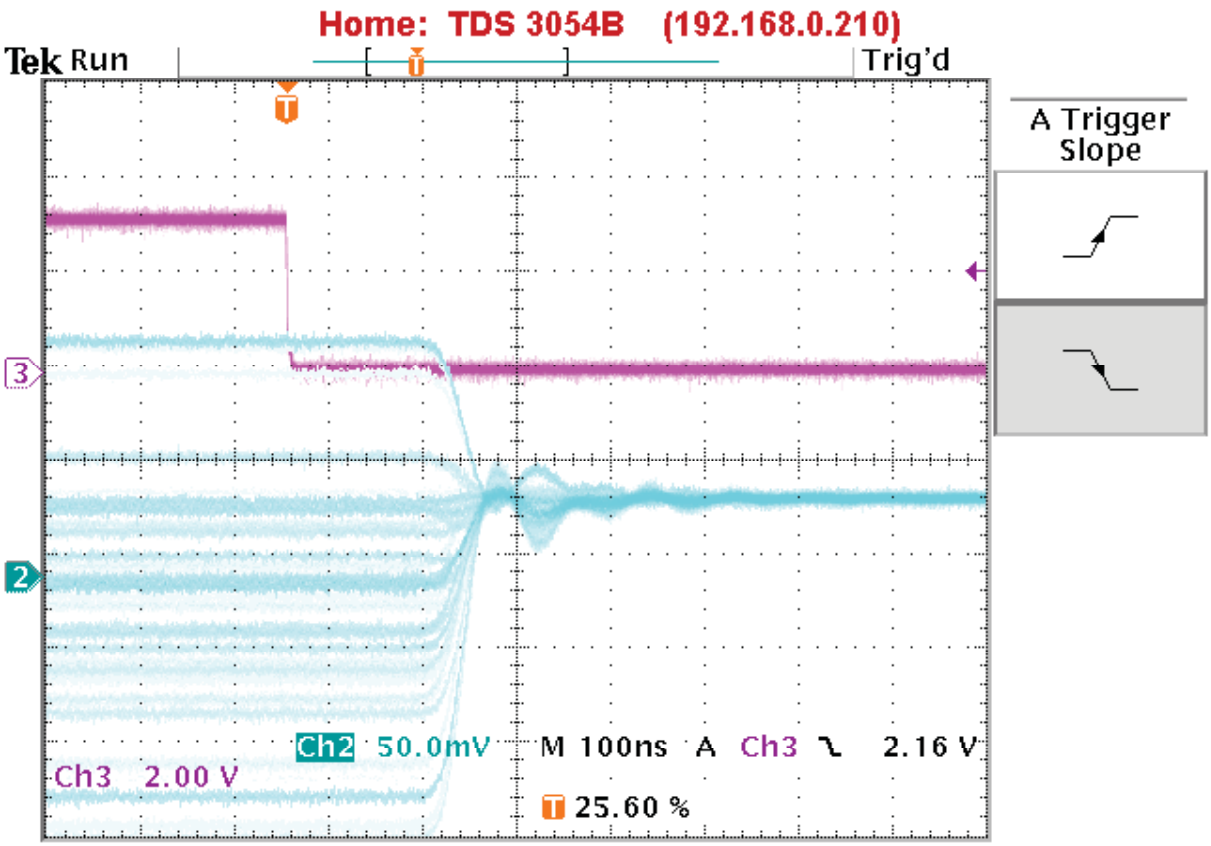

Figure 2

Note: All specifications subject to change without notice.

2-Tone Test Externally Triggered (Continued)

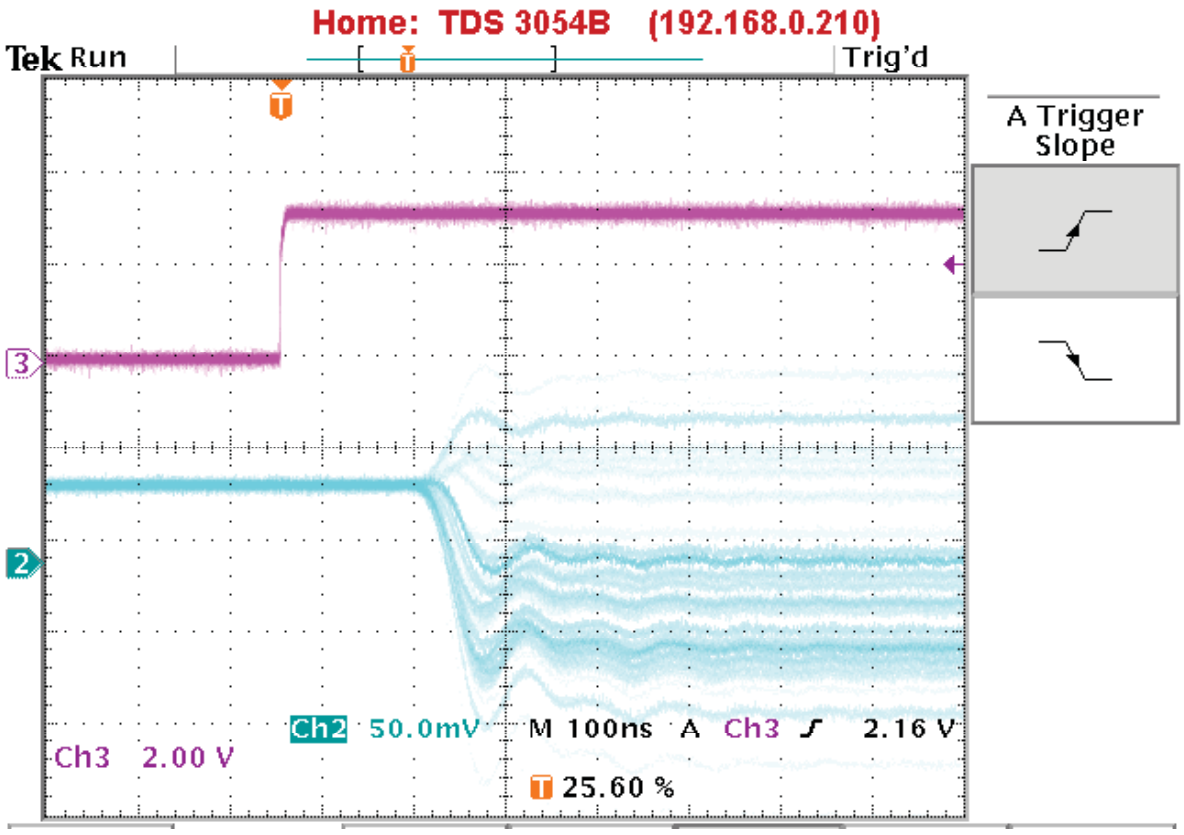

Figure 3

Four DDS Frequencies in Coherent Switching Mode

The Green trace [4] is a constant 400 MHz signal. The violet trace [3] is the switching signal to the Coherent DDS that switches it from some frequency other than 400 MHz to 400 MHz. The Cyan trace [2] is the coherent DDS output. Compare the phase of the reference signal at 400 MHz to the DDS signal returning to 400 MHz it always comes back with the same phase relationship. Thus no matter what frequency you go to when you come back you come back at the phase as if you never left that frequency. The constant phase relationship between the reference signal and DDS is maintained at roughly 180 degrees in this experiment.

By using band expansion, up conversion and frequency multiplication the Coherent DDS module operation can be band expanded while maintaining coherent switching. The H-CTI coherent switching DS can operate in the band from 2 to over 40 GHz.

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4-Tone Test - Internally triggered

- Green trace [4] = fixed external generator that is phase locked to the 400 MHz clock. It is set to one of the 4 frequencies.
- Cyan trace [2] = DDS output
- Violet trace [3]= trigger output representing the switching time. This display is continuously triggered on the violet trace
- The constant phase relationship of the green and cyan traces demonstrates coherency. Figures 4 thru 7 show the switched coherency among all four test frequencies.

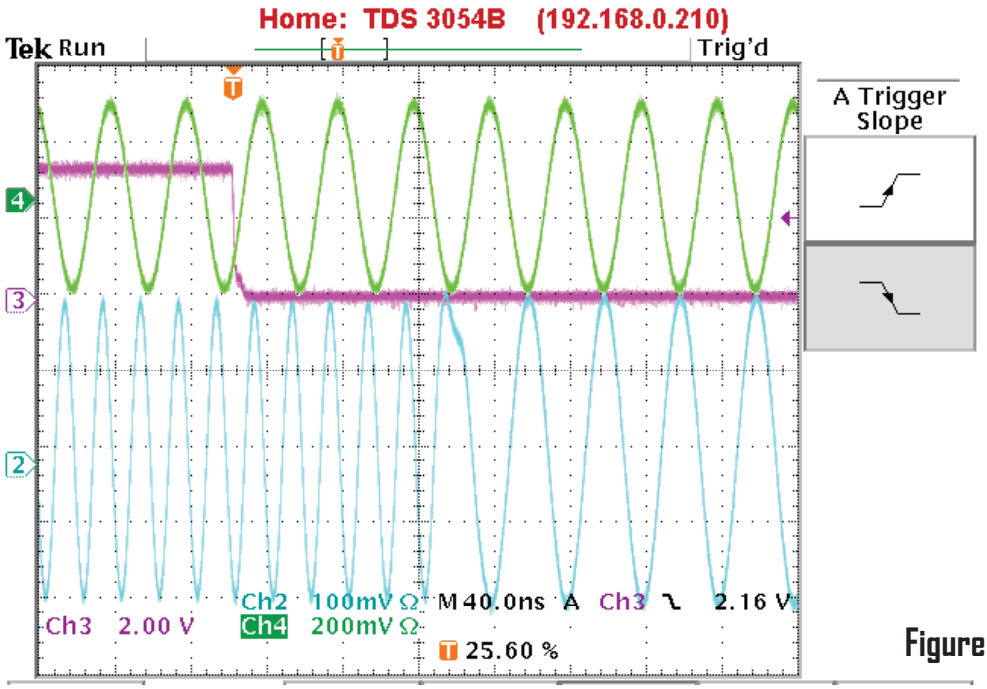

Figure 4

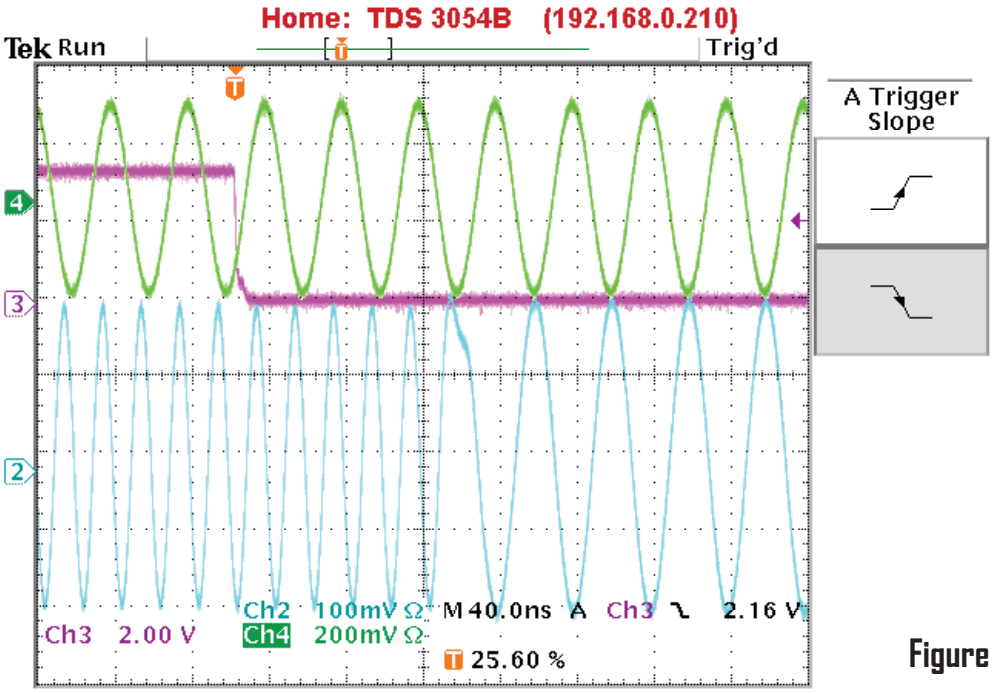

Figure 5

Note: All specifications subject to change without notice.

4-Tone Test - Internally triggered (Continued)

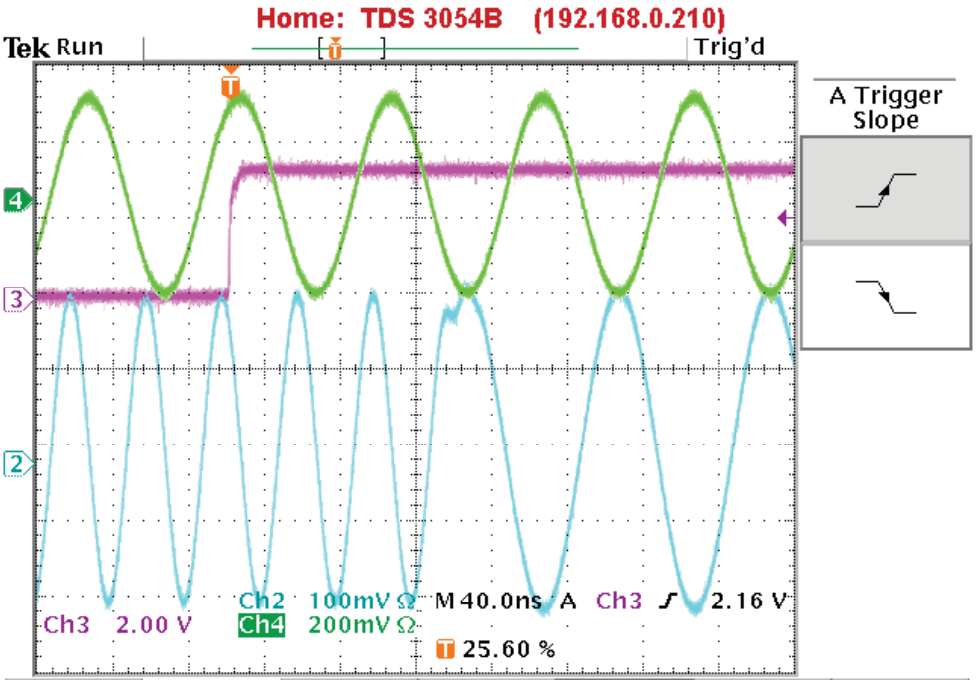

Figure 6

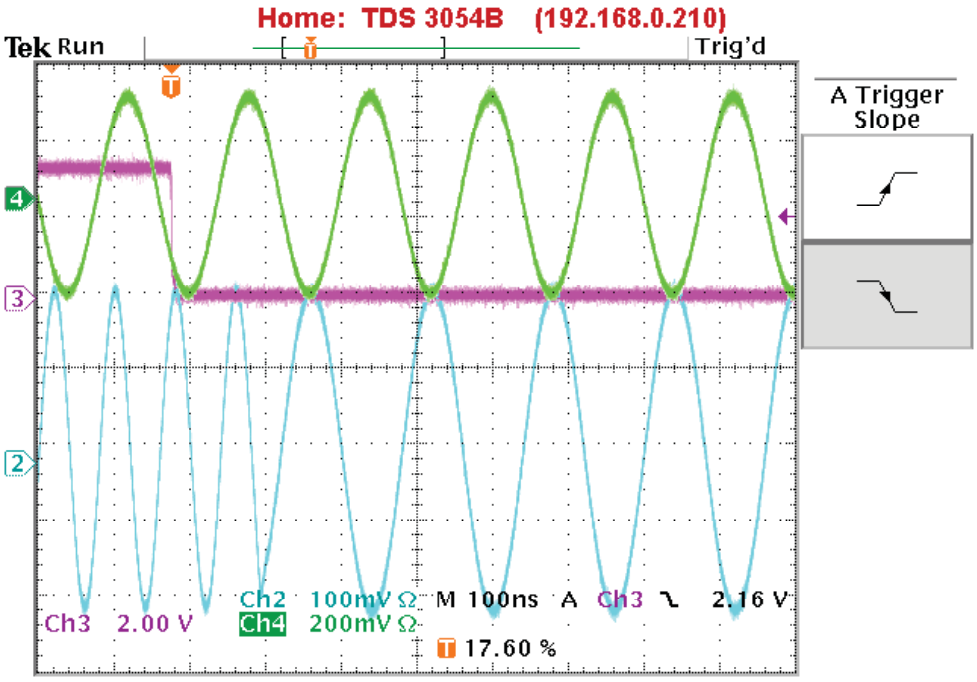

Figure 7

Note: All specifications subject to change without notice.

Coherent DDS in Continuous Mode

In limited bands the coherent switching DS unit can also be switched in a continuous mode. In order to achieve this, the H-CTI coherent switching DDS can be operated in a continuous mode.

4-Tone Test - Internally triggered

- Green trace [4] = fixed external generator that is phase locked to the 400 MHz clock. It is set to one of the 4 frequencies.
- Cyan trace [2] = DDS output
- Violet trace [3]= trigger output representing the switching time. Figures 8 thru 11 are continuously triggered on the violet trace
- The Cyan trace [2] illustrates phase continuity in the phase-continuous mode. It represents a "single-shot" picture of the frequency transition. If captured repeatedly, the phase transition point will be random (unlike the phase-coherent mode), but continuous.

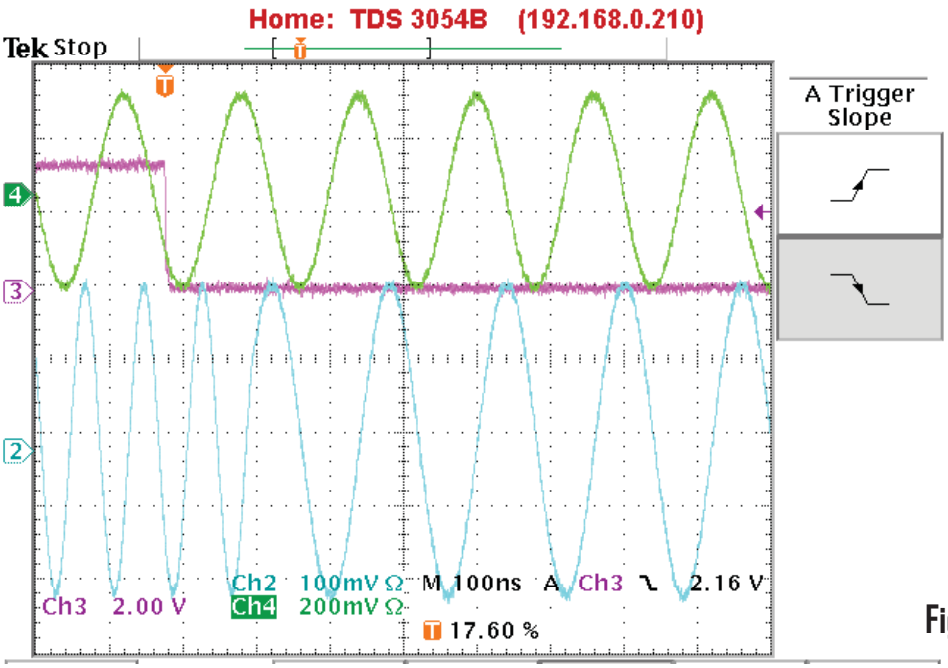

Figure 8

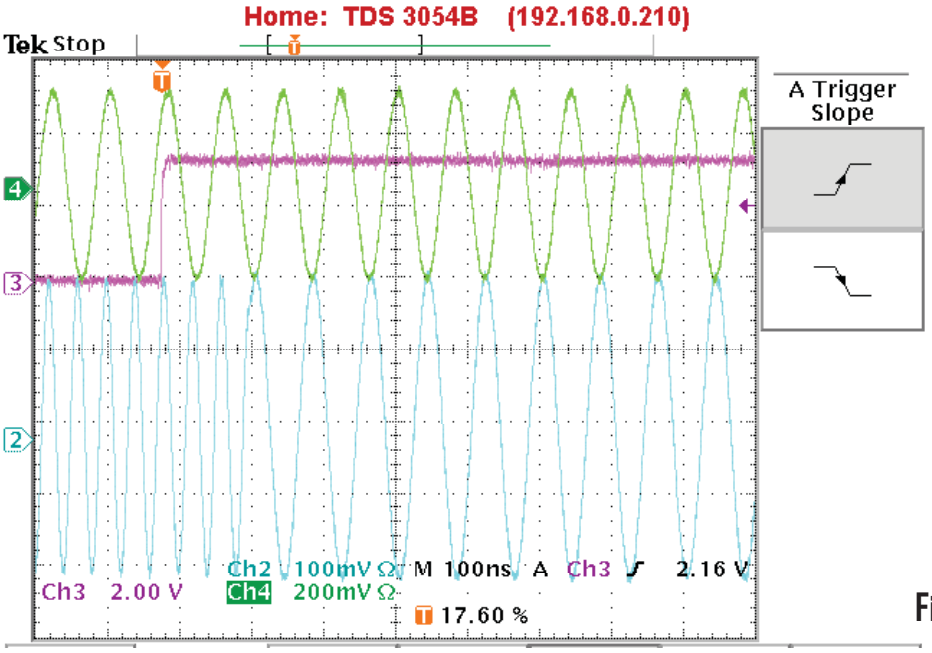

Figure 9

Coherent DDS in Continuous Mode (Continued)

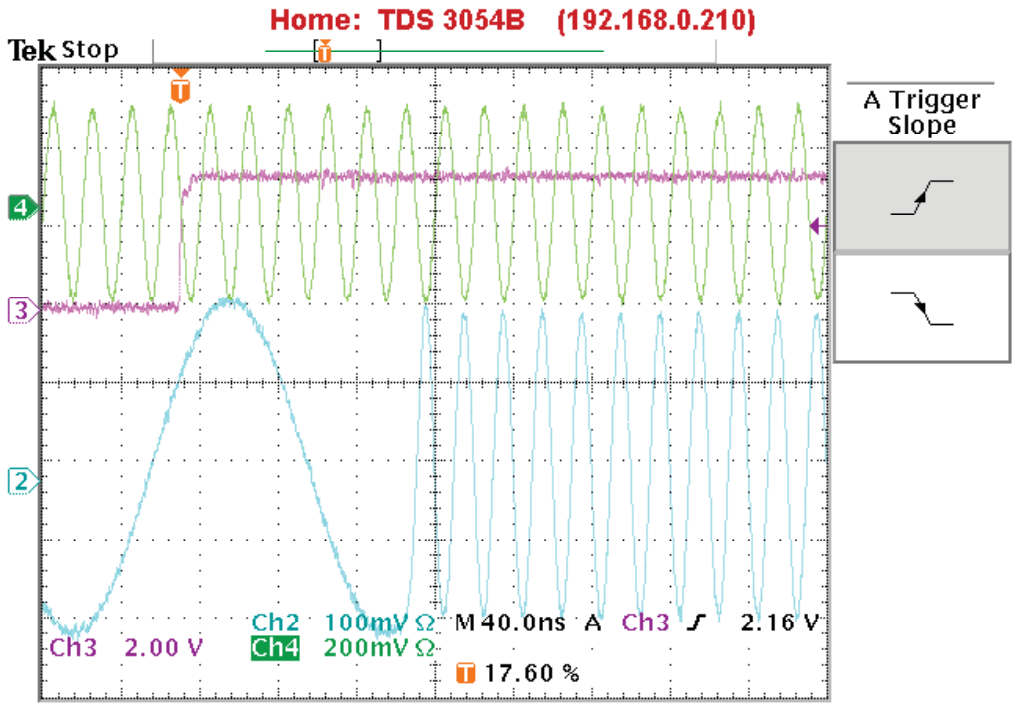

Figure 10

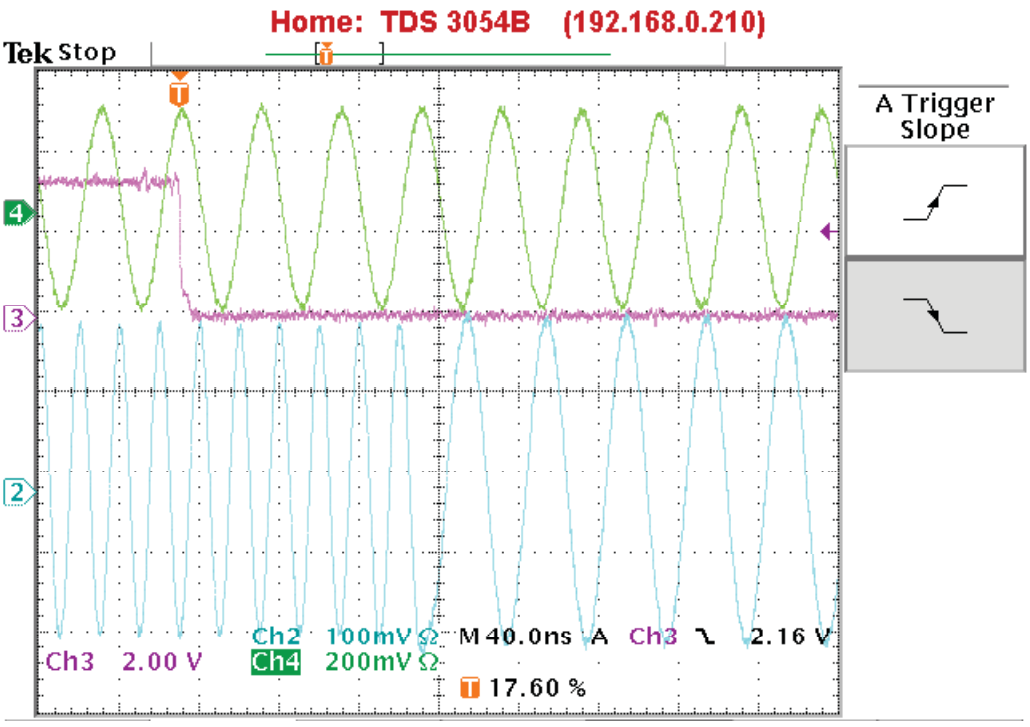

Figure 11

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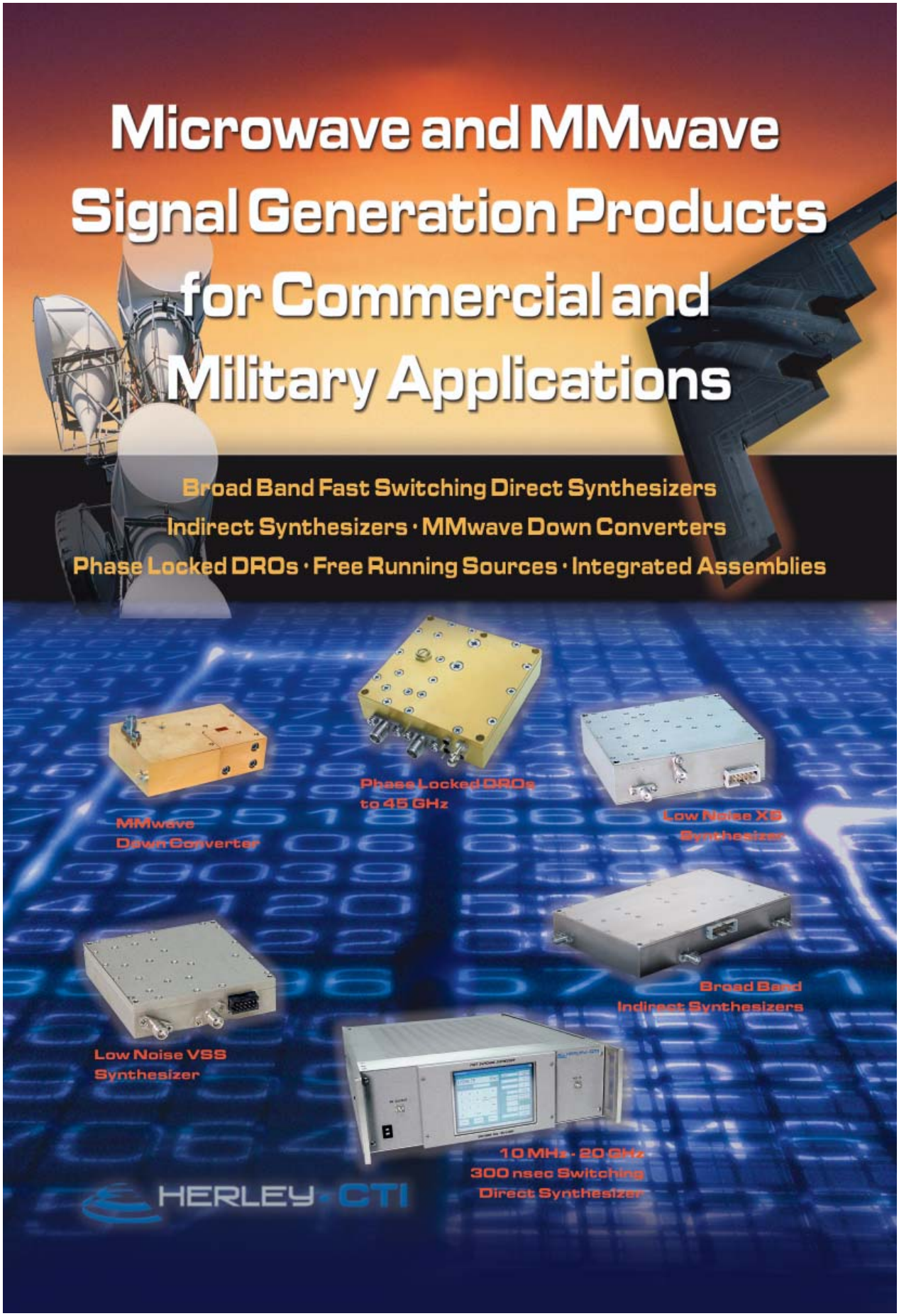
Direct Synthesizers



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