Model VXI-65CS4

VXI bus

Four (4) Instrument Synchro/Resolver Measurement Channels
Four (4) Instrument Synchro/Resolver Stimulus Channels
or
Eight (8) Embedded Grade Synchro/Resolver Stimulus Channels

FEATURES

** INSTRUMENT Grade (High Accuracy) and/or EMBEDDED Grade (Moderate Accuracy w/ High Channel Count) **

- Multiple functions on a single slot VXI card
- 0.005° Instrument Grade Measurement and Stimulus Accuracy
- 0.015° Embedded Grade Stimulus Accuracy (higher channel density / lower accuracy)
- 47 Hz to 4,000 Hz (see part number).
  For 47Hz to 10kHz (20kHz contact factory)
- User programmable output voltages
- 2.2 VA Outputs
- 2.2 VA or 5.2 VA Reference Generators
- Simultaneous and independent Measurement and Simulation
- Single-Speed or Multi-Speed Programmable for Measurement and Simulation
- Programmable Multi-Speed Ratios (2 to 255)
- Galvanic isolation (500 V)
- Dynamic address configuration
- VXIbus data rate of 2 megabytes/sec
- Data is processed within 100 μs
- Self-Test capability
- Auto-calibration -- No adjustments or trimming required

DESCRIPTION

This single slot VXI ("C"-size card) is an Instrument/Embedded Grade, intelligent DSP design, that incorporates up to four Synchro/Resolver Measurement channels, and up to four Instrument Grade Synchro/Resolver Simulation channels or up to eight Embedded Grade Synchro/Resolver (Simulation) channels that can be used independently and/or simultaneously.

- Instrument Grade is defined as 0.005° Accuracy
- Embedded Grade is defined as 0.015° Accuracy (less accurate than Instrument Grade but offers a higher channel density.

Four Reference Supplies are available. If > 2 Reference supplies are required, the additional Reference(s) will replace Stimulus channels (contact factory for special configurations).

All measurement and simulation channels are user programmable for either Synchro or Resolver format and may be formatted for either single-speed or multi-speed applications. Programmable speed ratios (2:1 to 255:1) offer additional flexibility for those applications requiring two-speed capability.
Each Simulation channel can be programmed for either continuous rotation or programmable Start and Stop angles.

This instrument contains all the necessary functions to fully evaluate, calibrate and simulate the Synchro/Resolver components and systems. With its built-in reference generators, superb accuracy, resolution and high power output capability, this module can form the basis of a fully integrated system for testing any Synchro/Resolver signal. This design also incorporates our new internal wrap-around Self Test capability that does not require any external hardware.

No alignment / adjustments required to maintain specified accuracy.

21st Century technology combined with nearly 50 years of synchro/resolver product experience yield state-of-the-art performance and accuracy.

GENERAL ARCHITECTURE

This universal card eliminates the need for specialized simulation and measurement for Synchro/Resolver components and systems. The card architecture consists of a motherboard with two daughter-boards that enable the user to specify a variety of functions within this single slot card design. (See part number for details).

The daughter-boards consist of independent measurement / stimulus / reference modules that may be populated to provide up to four Synchro/Resolver Measurement channels and up to four Instrument Grade Synchro/Resolver Simulation channels or up to eight Embedded Grade Synchro/Resolver (Simulation) channels that can be used independently and/or simultaneously.

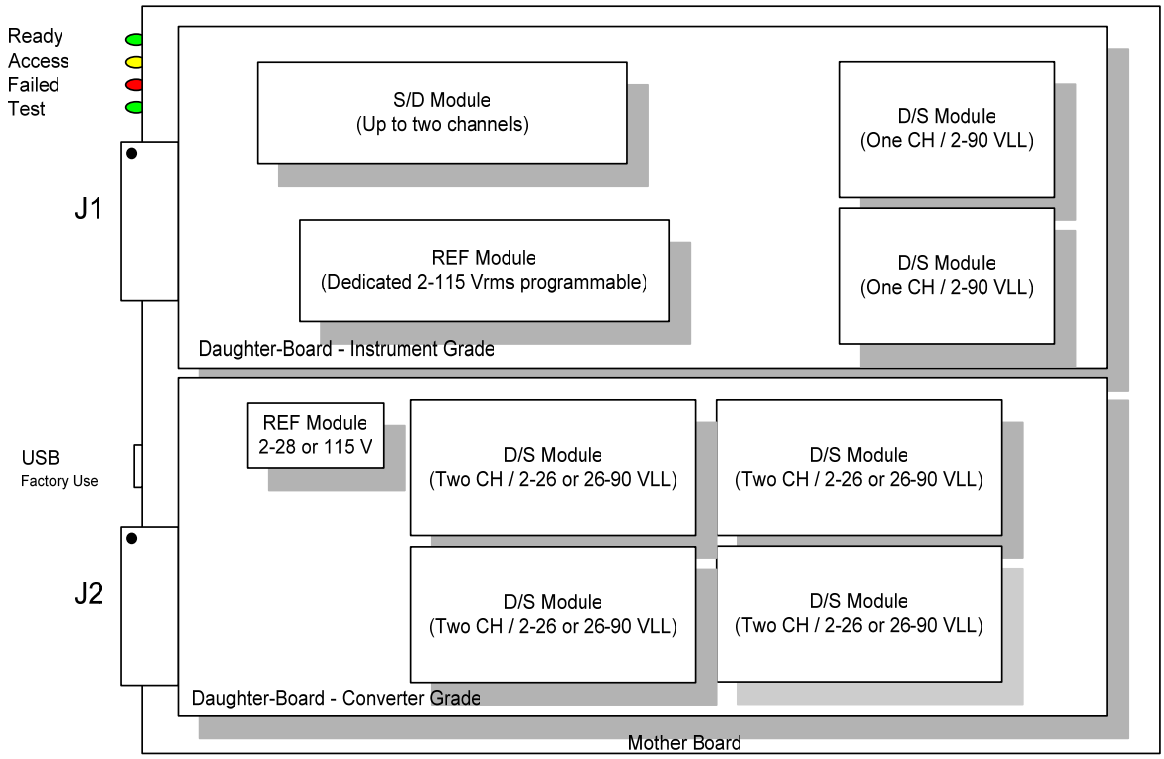


Fig 1. Instrument / Embedded Board Daughter Card Combination

– Typical configuration example: (Note) – One or two Daughter Boards can be mixed / matched (at factory / time of order) to suit configuration preference.

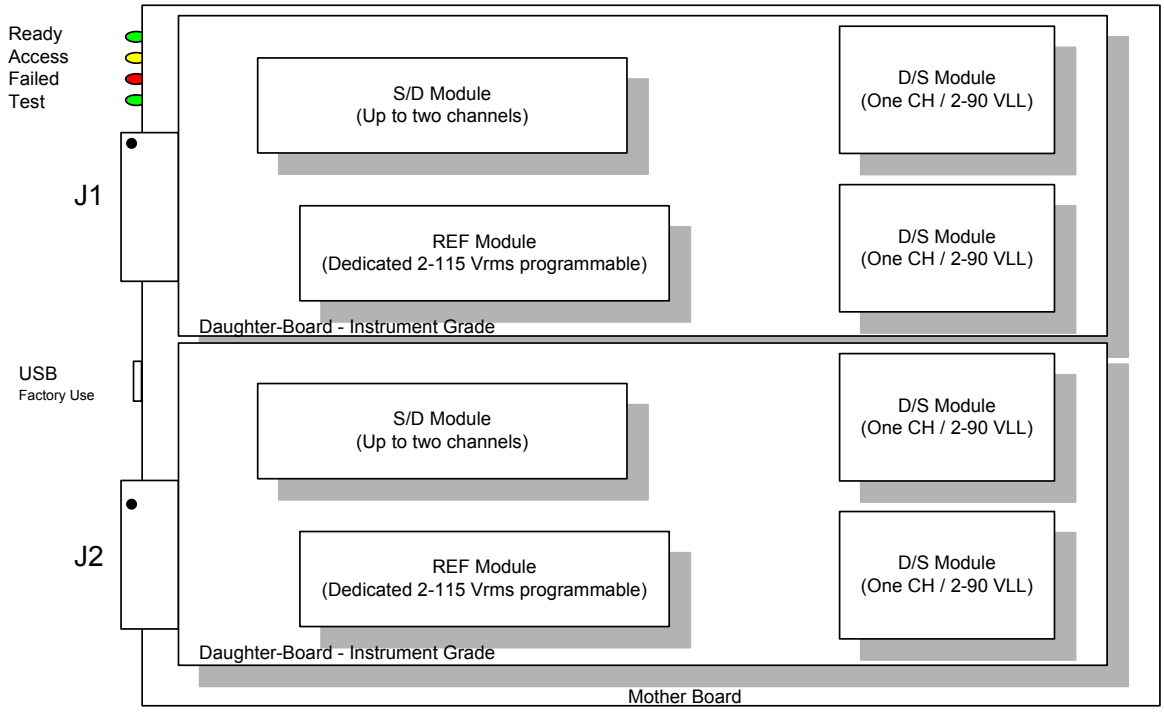


Fig 2. Dual Instrument Grade Daughter Board Combination

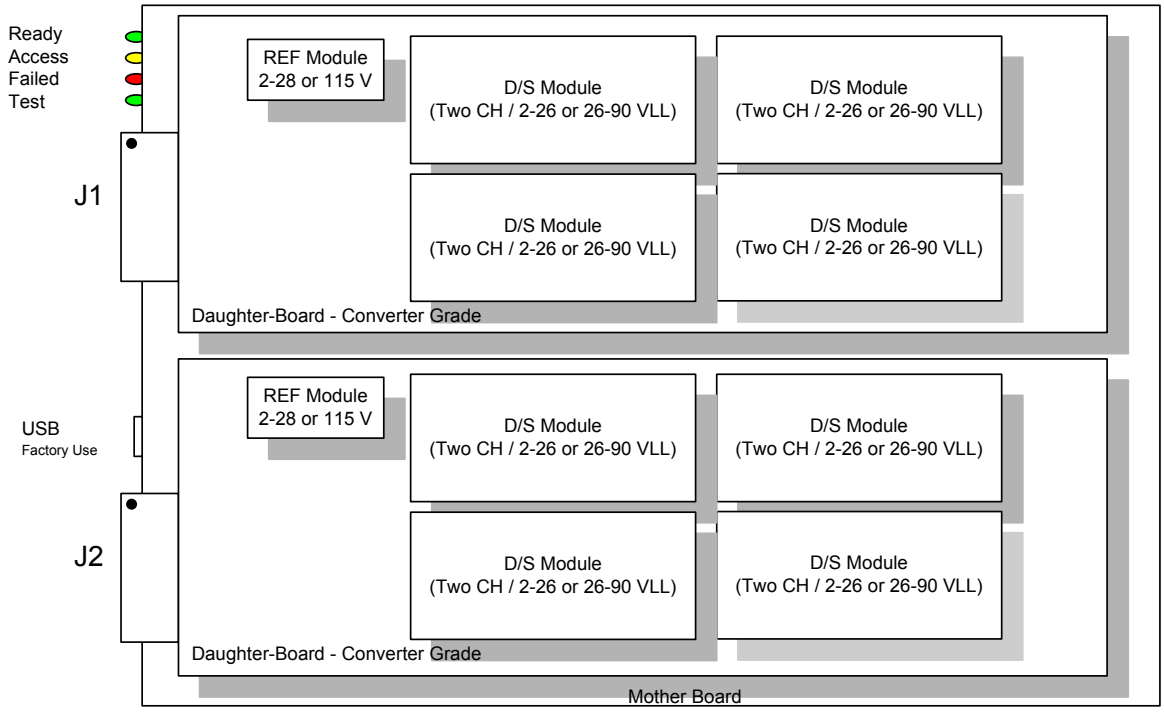


Fig 3. Dual Embedded Grade Daughter Board Combination

SPECIFICATIONS

(Motherboard) -- General

General	
DSP Design	Dedicated DSP for VXI Bus Data Transfer
VXI Bus Data transfer	2 MB/sec
Daughter Card Configuration	Up to (2) daughter-cards
ESD protection	Designed to meet the testing requirements of IEC 801-2 level 2 (4KV transient with a peak current of 7.5A with a time constant of approximately 60 ns.

Daughter-Board – Instrument Grade

General Configuration	Up to (2) Instrument Grade Measurement channels Up to (2) Instrument Grade Stimulus channels (1) Reference channel (may be increased in lieu of stimulus channels)

Instrument Grade Measurement, Input Module(s)

Number of Channels:	Up to four (see part number)
Input Mode: Angular	Synchro/Resolver, programmable
Range:	0 – 359.9999
Resolution:	0.0002°
Accuracy (Synchro/Resolver):	±.005° over frequency (See part number)
Input Voltage (Resolver):	1.0-90 VL-L Auto-ranging
Input Voltage (Synchro):	11.8-90 VL-L Auto-ranging
Input Impedance:	>11.8 VL-L 60kΩ; <11.8 VL-L 13.3 kΩ
Tracking Rate:	4.68 rps For two-speed applications, speed is referenced to the fine channel.
Angle Rate, Digital:	16-bit resolution; Linearity: 0.1%. Scalable to 0.1°/sec resolution.
Angle Rate, DC	Programmable from ±100 to ±1000°/sec = ±10 VDC (referred to Coarse input) 4 mA Short Circuit Protected
Speed Ratio:	Requires two channels, then the pair is programmable from 2:1 to 255:1 in increments of 1.
Input Reference, Frequency:	See part number
Reference, Voltage:	2 Vrms to 115 Vrms, Auto-ranging
Reference, Input Z:	100 kΩ
Auto phase Correction:	Up to 80° between Reference and Signal
Isolation:	Each Signal & Reference Input is galvanically isolated with 500 V peak breakdown over the specified frequency range.

Instrument Grade Stimulus, Output Module(s)

Number of Channels:	Four (see part number)
Output Mode:	Synchro/Resolver, programmable/channel
Resolution:	0.001°
Accuracy: (Resolver):	±.005° 360Hz to 800Hz
	±.010° >800Hz to 2,000Hz
(Synchro):	±.012° 47Hz to 100Hz
	±.005° >100Hz to 800Hz
Output Drive:	2.2 VA, ≥11.8 VL-L; 200 mA rms, <11.8 VL-L
Output voltage:	1.0 to 90 VL-L, programmable
Output Protection:	Over-current and over-temperature
Output VL-L Resolution:	0.01V. Output voltage varies directly with Reference voltage.
Output VL-L, Accuracy:	2% (relative to the reference voltage)
Input Reference, Frequency:	See part number
Reference, Voltage:	2 Vrms to 115 Vrms, programmable
Phase Shift:	2° max. Reference input to Signal output.
Speed Ratio:	Requires two channels, then the pair is programmable from 2:1 to 255:1 in increments of 1.
Rotation:	Continuous rotation or programmable Start and Stop angles. 0 to ±13.6 rps with a resolution of 0.15°/sec. Step size is 16 bits (0.0055)° up to 1.5 rps, then linearly decreases to 12 bits (0.088°) at 13.6 rps.
Velocity Output, DC	±1000 °/sec = ±10 VDC (referred to Coarse output)
	±100 °/sec = ±10 VDC
	4 mA Short Circuit Protected
Accuracy Velocity Output	±0.25% FS (Full Scale) Gain ±10mV offset
Isolation:	Each Signal & Reference Input is galvanically isolated with 500 V peak breakdown over the specified frequency range.

Reference Generator

(Available on Instrument Grade Daughter Board)

Number of Channels:	Six (see part number)
Voltage Output:	2 Vrms to 115 Vrms, Programmable
Resolution:	0.1 V
Accuracy, voltage:	±3%
Harmonic Content:	1.0% maximum
Output Drive Capability:	2.2 VA
Output Protection:	Over-current and over-temperature
Frequency:	47 Hz to 10 kHz Programmable with 0.1 Hz steps
Accuracy, frequency:	0.1%

Daughter-Board – Embedded Grade

General Configuration — Up to (8) Embedded Grade Stimulus channels
(1) Reference module; 2-28 Vrms or 115 Vrms (see part number)

Embedded Grade Stimulus, Output

Number of Channels:	Eight (see part number)
Output Mode:	Synchro/Resolver, programmable/channel
Resolution:	0.1°
Accuracy (Synchro/Resolver):	±0.02° over frequency of 340 Hz to 1,000Hz;
Output Drive:	1.25 VA at 70°
Output Protection:	Over-current and over-temperature
Output VL-L	2.0 to 26 VL-L, programmable; resolution 0.01V Output voltage varies directly with Reference voltage.
Output VL-L, Accuracy:	2% (relative to the reference voltage)
Reference, Frequency:	360 Hz to 1,000 Hz
Reference, Voltage:	26 Vrms, 90 Vrms, or 115 Vrms, programmable
Phase Shift range:	±179.9° Reference input to Signal output.
Phase shift resolution:	0.1°
Phase shift accuracy:	Offset 0.5°max. then linearity is 0.1° over range.
Rotation:	Continuous rotation or programmable Start and Stop angles. 0 to ±13.6 rps with a resolution of 0.15°/sec. Step size is 16 bits (0.0055)° up to 1.5 rps, then linearly increases to 12 bits (0.088°) at 13.6 rps.
Isolation:	Each Signal & Reference Input is galvanically isolated with 500 V peak breakdown over the specified frequency range.

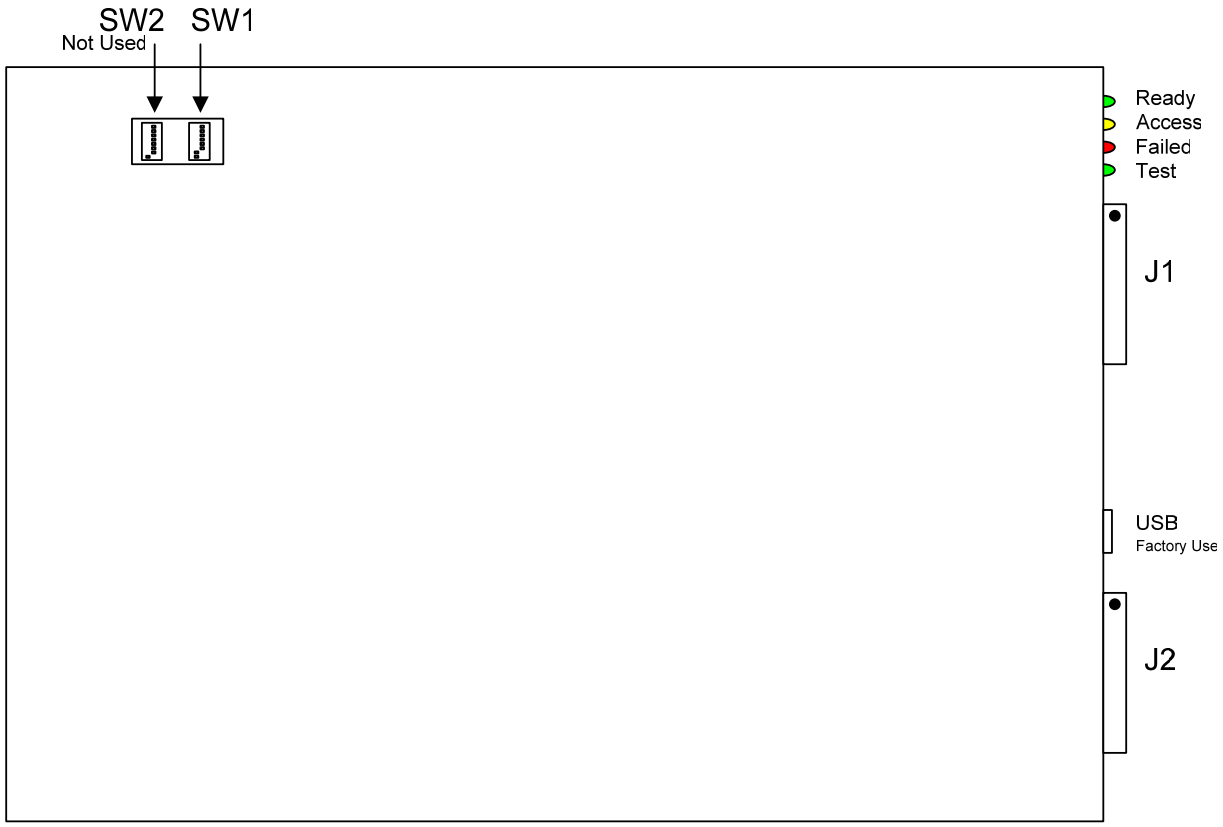
Applicable to the Overall Card:

VXIBus Data Rate:	2 megabytes/second
Trigger:	Rotation may be initiated by either an external (Front Panel) or via the trigger bus. External trigger is terminated with a 499 Ω resistor and is connected to a differential Line Receiver (SN75115N). Trigger input to be 8 microseconds min. width.
Data states:	Track or freeze for Measurement channels only
Temperature, Operating:	0°C to +50°C
Temp. Non-Operating:	-40°C to +71°C
Relative Humidity:	to 95% RH non-condensing
Shock:	Designed to meet 15G, 11 ms
Vibration:	Designed to meet MIL-PRF-28800F for class 3 equipment.
Altitude, Operating:	10,000 feet
Altitude, Non-Operating:	40,000 feet
Power Requirements:	+5 VDC 8A at no load; 14A with all channels fully loaded
Size:	"C" size (13.386" x 9.187"), 1.2" pitch. (349mm x 234 mm),30 mm pitch
Weight:	4.3 lb.
Calibration Intervals:	Verification is suggested every two years

CARD ADDRESS

Address Dip Switch 1 can be configured for logical addresses 1 to 255, where OFF=1 and ON=0. LSB is position 1. Card SW1 is default configured for logical address 128, to address the first set of 8 channels. (Address Dip Switch 2 is not used).

Decimal	Logical Address 128 (Default)	Logical Address 33 (Example)
1 (LSB)	SW1, position 1=0 (ON)	SW1, position 1=1 (OFF)
2	SW1, position 2=0 (ON)	SW1, position 2=0 (ON)
4	SW1, position 3=0 (ON)	SW1, position 3=0 (ON)
8	SW1, position 4=0 (ON)	SW1, position 4=0 (ON)
16	SW1, position 5=0 (ON)	SW1, position 5=0 (ON)
32	SW1, position 6=0 (ON)	SW1, position 6=1 (OFF)
64	SW1, position 7=0 (ON)	SW1, position 7=0 (ON)
128 (MSB)	SW1, position 8=1 (OFF)	SW1, position 8=0 (ON)



65CS1 Bottom View

FRONT PANEL STATUS INDICATORS

Status Indicators	Function
READY	Indicates that unit is ready to accept commands
ACCESS	Illuminates when VXI bus controller sends or reads a message or status.
FAILED	Lights on power-up and goes out after unit has passes system self-test (approx one minute). Stays lit if device has failed Self-Test or Calibration. Indicator will also light in response to Controller SYSFAIL output
TEST	Illuminates while Internal Self-Test is running. Flashes during Calibration cycle.

PROGRAMMING

One VXI 65CS4 supports up to 4 channels of measurement and/or stimulus. Use SW1 to configure the address for those channels. (SW2 is not used). Use Native Syntax to address any channel of that associated logical address.

Self-test can be performed at any time without effecting any set parameters. Self-test requires approximately 45 seconds to complete.

TO POWER ON CARD AND ENABLE OPERATION, user must send command *IDN?
Perform self-test (*TST?<CR><LF>) before programming. Testing is complete in approximately 45 seconds.

The following sections define Native programming format with supporting examples

Formal Syntax Notation

< >	field boundaries of inseparable and mandatory items
[ ]	field boundaries of optional items
( )	grouping braces
::=	"is defined to be"
|	alteration, exclusive OR
…	optional repetition of immediately preceding item or group

General Command Definition

<value>	(ASCII encoded scientific number | ASCII encoded decimal number | ASCII encoded integer) All <*values*> The resolution (number of decimal places is dependent on the specific command sent. Higher resolutions will be accepted but will be truncated to the acceptable number of digits to the right of the decimal point.
<scientific number>	[+ | -] [<*digit*>…] <*dp*><*digit*>…E<+ | -><*digit*>[<*digit*>]
<decimal number>	([+ | -]<*digit*>…<*dp*> [<*digit*>…] | [+ | -]<*dp*><*digit*>…)
<integer>	[+ | -]<*digit*>…
<channel>	<*digit*>
<*dp*>	ASCII decimal point (period) "."
<*digit*>	(0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9)
<*b*>	one or more ASCII blank characters
<*cr*>	ASCII carriage return
<*lf*>	ASCII line feed
<grade>	[<H> | <L>] (H = Instrument Grade, L = Embedded Grade) The grade option is utilized to differentiate between instrument grade and embedded grade functions for S/D and D/S modules

Detailed Command Syntax

SIMULATOR COMMANDS

Angle	
DS<grade><channel><*b*>ANGLE<*b*><value><*cr*><*lf*>	Sets output angle (in degrees): Range: -359.9999 < value < 359.9999
DS<grade><channel><*b*>ANGLE?<cr><*lf*>	Queries Angle returns value in uni-polar mode: Range: 0.0000 < value < 359.9999
DC Scale	
DS<grade><channel><*b*> DC_SCALE<*b*><value><*cr*><*lf*>	Sets Channel DC output Scale; Full scale = 10Volts Range: 100 <= value <= 1000. (e.g. 100 = 10 degrees / sec / V)
DS<grade><channel><*b*>DC_SCALE?<cr><*lf*>	Query returns Channel DC Scale value
Signal Mode	
DS<grade><channel><*b*>MODE<*b*>RSL<*cr*><*lf*>	Sets channel signal format (mode) to RESOLVER
DS<grade><channel><*b*>MODE<*b*>SYN<*cr*><*lf*>	Sets channel signal format (mode) to SYNCHRO
DS<grade><channel><*b*>MODE?<cr><*lf*>	Query returns current Signal Mode (‘RSL’ or ‘SYN’)
Ratio	
DS<grade><channel><*b*>RATIO<*b*><value><*cr*><*lf*>	Sets 2-speed ratio; Range = 2 to 255. Ratio is 1 for independent outputs.
DS<grade><channel><*b*>RATIO?<cr><*lf*>	Query returns Ratio setting.
Relay Function	
DS<grade><channel><*b*> STATE<*b*>< OPEN | CLOSE ><*cr*><*lf*>	Sets I/O isolation relay state; “OPEN” or “CLOSE”.
DS<grade><channel><*b*>STATE?<cr><*lf*>	Query returns I/O relay status “OPENED” or “CLOSED”.
Reference Mode	
DS<grade><channel><*b*> REF_SOURCE<*b*>< INT | EXT ><*cr*><*lf*>	Sets Channel Reference Source; INT=Internal or EXT=External Internal Source Channels 1 & 2 is Reference 1. Internal Source Channels 3 & 4 is Reference 2.
DS<grade><channel><*b*>REF_SOURCE?<cr><*lf*>	Query returns Channel Reference Mode (‘INT’ or ‘EXT’)
Line-to-Line Voltage	
DS<grade><channel><*b*> VLL_VOLT<*b*><value><*cr*><*lf*>	Sets Line-to-Line voltage in Volts. Range:1 to 90.
DS<grade><channel><*b*>VLL_VOLT?<cr><*lf*>	Query returns current Line-to-Line Voltage value
Input Reference Voltage	
DS<grade><channel><*b*> REF_VOLT_IN<*b*><value><*cr*><*lf*>	Configure Channel for Input Reference Voltage Level. Does not apply when Reference Source is Internal. Range: 2.0 to 115.0
DS<grade><channel><*b*>REF_VOLT_IN?<cr><*lf*>	Query returns Channel Input Reference Voltage Level Setting

Rotation Complete DS<grade><channel><*b*>ROT_DONE?<cr><*lf*>	Query returns Step Rotation Status (“YES”=Done or “NO”=Step not complete). Only applies when in Step Rotation Mode.
Rotation Initialization DS<grade><channel><*b*>ROT_INIT<*b*><*cr*><*lf*>	Command initiates rotation of channel output.
Rotation Rate DS<grade><channel><*b*> ROT_RATE<*b*><value><*cr*><*lf*> DS<grade><channel><*b*>REF_RATE?<cr><*lf*>	Set channel Rotation Rate in revolutions per second (RPS). Range: 0.15 to 13.60 Query returns programmed channel Rotation Rate.
Rotation Stop Angle DS<grade><channel><*b*> ROT_STOP_ANGLE<*b*><value><*cr*><*lf*> DS<grade><channel><*b*> ROT_STOP_ANGLE?<cr><*lf*>	Sets channel output angle (in degrees): Range: -359.9999 < value < 359.9999 Queries returns Channel Stop Angle in uni-polar mode: Range: 0.0000 < value < 359.9999
Rotation Mode DS<grade><channel><*b*> REF_MODE<*b*>< CONT | STEP ><*cr*><*lf*> DS<grade><channel><*b*>REF_SOURCE?<cr><*lf*>	Sets Channel Reference Source; CONT=Continuous or STEP=Step Query returns Channel Rotation Mode (‘CONT’ or ‘STEP’)
Trigger Source DS<grade><channel><*b*>TRIG_SOURCE<*b*>< BUS | INT | EXT | TTL ><*cr*><*lf*> DS<grade><channel><*b*> TRIG_SOURCE?<cr><*lf*>	Sets Channel Trigger Source; BUS=Bus, INT=Internal, EXT=External, or TTL=TTL Level Query returns Channel Trigger Source (‘BUS’,’INT’,‘EXT’,or TTL’)
Trigger Slope DS<grade><channel><*b*>TRIG_SLOPE<*b*>< NEG | POS ><*cr*><*lf*> DS<grade><channel><*b*> TRIG_SLOPE?<cr><*lf*>	Sets Channel Trigger Sense for Positive or Negative going level; NEG=Negative, POS=Position Query returns Channel Trigger Sense (‘NEG’, or ’POS’)
Phase Shift DS<grade><channel><*b*>PHASE<*b*><value><*cr*><*lf*> DS<grade><channel><*b*>PHASE?<cr><*lf*>	Sets Channel Phase (degrees); Range ±180.0 Query returns Channel Phase (degrees); Range: ±180

API COMMANDS

Angle SD<grade><channel><*b*> ANGLE?<*b*><value><*cr*><*lf*>	Query returns API angle (in degrees): Range: 0.0000 < value < 359.9999
DC Scale SD<grade><channel><*b*> DC_SCALE<*b*><value><*cr*><*lf*>	Sets Channel DC output Scale; Full scale = 10Volts Range: 100 <= value <= 1000. (e.g. 100 = 10 degrees / sec / V)

SD<grade><channel><*b*>DC_SCALE?<cr><*lf*>	Query returns Channel DC Scale value
Bandwidth SD<grade><channel><*b*> BANDWIDTH<*b*>< HIGH | LOW ><*cr*><*lf*> SD<grade><channel><*b*>BANDWIDTH?<cr><*lf*>	 Sets Channel for either High or Low Bandwidth (BW); HIGH=100 Hz BW or LOW= 10 Hz BW Use LOW for carrier (reference) freq <300Hz. Query returns Channel Bandwidth ('HIGH' or 'LOW')
Maximum Angle Settle Time SD<grade><channel><*b*>MAXT<*b*><value><*cr*><*lf*> SD<grade><channel><*b*>MAXT?<cr><*lf*>	 Maximum wait time for settled API reading. Sets channel Max ? (in ?): Range: 0 < value < 20 Queries returns Channel Max ?.
Signal Mode SD<grade><channel><*b*>MODE<*b*>RSL<*cr*><*lf*> SD<grade><channel><*b*>MODE<*b*>SYN<*cr*><*lf*> SD<grade><channel><*b*>MODE?<cr><*lf*>	 Sets channel signal format (mode) to RESOLVER Sets channel signal format (mode) to SYNCHRO Query returns current Signal Mode ('RSL' or 'SYN')
Ratio SD<grade><channel><*b*>RATIO<*b*><value><*cr*><*lf*> SD<grade><channel><*b*>RATIO?<cr><*lf*>	 Sets channel 2-Speed/Multi-speed ratio; Range = 1 to 255. Query returns channel 2-Speed/Multi-speed ratio setting.
Reference Mode SD<grade><channel><*b*> REF_SOURCE<*b*>< INT | EXT ><*cr*><*lf*> SD<grade><channel><*b*>REF_SOURCE?<cr><*lf*>	 Sets Channel Reference Source; INT=Internal or EXT=External Internal Source Channels 1 & 2 is Reference 1. Internal Source Channels 3 & 4 is Reference 2. Query returns Channel Reference Mode ('INT' or 'EXT')
Relay Function SD<grade><channel><*b*> STATE<*b*>< OPEN | CLOSE ><*cr*><*lf*> SD<grade><channel><*b*>STATE?<cr><*lf*>	 Sets I/O isolation relay state; "OPEN" or "CLOSE". Query returns I/O relay status "OPENED" or "CLOSED".
Measurement Mode SD<grade><channel><*b*> UPDATE<*b*>< LATCH | TRACK ><*cr*><*lf*> SD<grade><channel><*b*>UPDATE?<cr><*lf*>	 Sets API channel Update Mode to "LATCH" or "TRACK". Query returns channel Update mode "LATCHED" or "TRACKING".
Velocity SD<grade><channel><*b*>VEL?<*b*><value><*cr*><*lf*>	 Query returns channel velocity Range: -32767 < value < 32767. Typically ±10,000dps.

REFERENCE COMMANDS

Reference Generator Frequency REF_GEN<channel><*b*> FREQ<*b*><value><*cr*><*lf*>	Sets internal Reference Generator frequency in Hz. Range = 47.00 to 10000.00z.
REF_GEN <channel><*b*>FREQ?<cr><*lf*>	Query returns Reference Generator frequency setting.
Relay Function REF_GEN<channel><*b*> STATE<*b*>< OPEN | CLOSE ><*cr*><*lf*>	Sets I/O isolation relay state; “OPEN” or “CLOSE”.
REF_GEN <channel><*b*>STATE?<cr><*lf*>	Query returns I/O relay status “OPENED” or “CLOSED”.
Reference Generator Voltage REF_GEN<channel><*b*> VOLT<b><value><cr><lf>	Sets internal Reference Generator voltage; Range = 2 to 115 volts.
REF_GEN <channel><*b*>VOLT?<cr><lf>	Returns internal Reference Generator voltage setting.

UTILITY FUNCTIONS

Self-Test *TST?<*cr*><*lf*>	Initiates self-test. Query returns 0<*cr*><*lf*> if test passed or SELF TEST FAILED...<*cr*><*lf*> if test failed. Self-test requires approximately 45 seconds to complete.
Identification *IDN?<*cr*><*lf*>	Returns: “north atlantic, <part number>,<serial #>, <firmware revision>“ **THIS COMMAND IS REQUIRED TO POWER ON CARD AND ENABLE OPERATION.**
Error Reporting *ERR?<*cr*><*lf*>	Query returns up to 10 most recent error messages or “No error.” To clear error queue, read until “No error” is received.

Reset *RST<*cr*><*lf*>	Sets unit to power-up default state: SD MAXT = 0 SD BANDWIDTH = HIGH SD DC SCALE = 1000 SD RATIO = 1 SD REF SOURCE = EXT SD STATE = OPEN SD UPDATE = TRACK REF FREQ = 400 REF VOLT = 115 REF STATE = OPEN DS ANGLE = 0.0000 DS DC SCALE = 1000 DS MODE = SYN DS RATIO = 1 DS REF SOURCE = EXT DS REF VOLT = 115 DS ROT RATE = 0 DS STOP ANGLE = 0.0000 DS ROT MODE = CONT DS STATE = OPEN DS TRIG SLOPE = POS DS TRIG SOURCE = INT DS VLL VOLT = 90

Instrument Setup Queries.
Any Model 65CS4 setup state or value may be queried by sending the command mnemonic with a question mark (?) appended and reading the response. See *Command Definition Section* for detailed command syntax. Valid instrument queries are summarized as follows:

Query	Purpose/Response
ANGLE?	Generator output angle or API reading
DC_SCALE?	Return DC Scale
MODE?	Synchro (SYN) or Resolver (RSL) mode
VLL_VOLT?	Line-to-Line input/output voltage value
RATIO?	Speed Ratio value
REF_VOLT_IN?	Input Reference Voltage Setting
ROT_DONE?	Step Rotation Status
REF_RATE?	Rotation Rate
ROT_STOP_ANGLE?	Stop Angle
REF_SOURCE?	Reference Internal (INT) or External (EXT)
TRIG_SOURCE?	Trigger Source
TRIG_SLOPE?	Trigger Slope
BANDWIDTH?	Returns Bandwidth
MAXT?	API stable measurement timeout value
STATE?	Relay State OPENED or CLOSED
UPDATE?	Generator velocity value
VEL?	Velocity
*TST?	Self test status. Self-test requires approximately 45 seconds to complete.
*IDN?	Instrument Identification string. **REQUIRED TO POWER ON CARD AND ENABLE FOR OPERATION**
*ERR?	Returns 10 recent error messages

CALIBRATION

This design also incorporates our new internal calibration capability that continually calibrates the Synchro functions without interfering with the normal operation of this instrument.

Verification approximately every two years is suggested.

CALIBRATION VERIFICATION TEST SET-UP

This unit does not require field calibration. Use the following setup to verify performance that may be performed approximately every two years.

The below tests will not necessarily assure conformance to all specification limits but will verify that all features are functional. Each test is presented in a step-by-step format and references a test equipment setup diagram. The test equipment setup figure illustrates the complement of test equipment necessary to perform the test for a single or pair of channels and shows all required interconnections between the test equipment and the device under test (DUT) using the standard J1 configuration #1. As applicable, all tests can be repeated as required to test the remaining channels (see part number).

NOTE(s):

1. After applying power to the DUT, *idn? Command must be sent to “internally” power up the DUT.
2. The following is general instructions – use the following as a guideline insuring the use of the <grade> variable for DS and SD commands (i.e. substitute DSH, SDH for Instrument Grade type and DSL, SDL for Embedded Grade type).
3. The following general test methods/verification is for general test of each module type with external test equipment. Other testing methods/equivalent test equipment may be used.

Internal Reference Checkout Procedure

a. Set up equipment as shown in Figure 1.

b. Program DUT using the following commands strings:

REF_GEN1 FREQ 400.00
REF_GEN1 VOLT 26.0
REF_GEN1 STATE CLOSE

d. Verify that the Frequency reading on the DMM is programmed value ±2%..

d. Verify that the Fundamental Voltage reading on the DAV (read REF channel) is programmed value ±0.1%.

e. Verify that the Distortion Measurement on the DAV (read REF channel) is less than 1.0%.

f. Program DUT to 115V with the following string and repeat steps (c) through (e) above.

REF_GEN1 VOLT 115.0

g. Program DUT to 6V with the following string and repeat steps (c) through (e) above.

REF_GEN1 VOLT 6.0

h. Program DUT to 47Hz with the following string and repeat steps (c) through (g) above (for 5395-F2 only).

REF_GEN1 FREQ 47.00

i. Program DUT to 2000Hz with the following string and repeat steps (c) through (g) above.

REF_GEN1 FREQ 2000.00

Single-Speed Generation (Simulator) Internal Reference Checkout Procedure

a. Set up equipment as shown in Figure 2.

b. Program DUT using the following command strings:

DS1 REF_SOURCE INT

REF_VOLT_IN 115.0
REF_GEN1 FREQ 47.00
REF_GEN1 VOLT 115.0
DS1 VLL_VOLT 90.0

DS1 MODE SYN
DS2 RATIO 1
DS1 CLOSED
REF_GEN1 STATE CLOSE

c. For each angle listed below, make connections to DAV SIG HI and SIG LO as shown. Program each specified angle using the ANGLE 3 <value> command.

Angle	Connections
0.000	S3 to HI, S1 to LO
60.00	S3 to HI, S2 to LO
120.0	S1 to HI, S2 to LO
180.0	S1 to HI, S3 to LO
240.0	S3 to HI, S2 to LO
300.0	S1 to HI, S2 to LO

d. Verify that each in-phase voltage reading is within the limits specified:

limit: 0±23.56mV in-phase

e. Program DUT to 400Hz using the following command string:

REF_GEN1 FREQ 400.00

f. Repeat step (c) above.

g. Verify that each in-phase voltage reading is within the limits specified:

limit: 0±7.853mV in-phase

h. Program DUT to Resolver Mode, 26V L-L, 26V reference using the following command string:

DS1 MODE RSL
REF_GEN1 VOLT 26.0
DS1 VLL_VOLT 26.0

i. For each angle listed below, make connections to DAV SIG HI and SIG LO as shown. Program each specified angle using the ANGLE<value> command.

Angle	Connections
0.000	S1 to S4, S3 to HI, S1 to LO
45.00	S1 to S4, S3 to HI, S2 to LO
90.00	S1 to S2, S2 to HI, S4 to LO
135.0	S1 to S2, S3 to HI, S4 to LO
180.0	S1 to S4, S3 to HI, S1 to LO
225.0	S1 to S4, S3 to HI, S2 to LO
270.0	S1 to S2, S2 to HI, S4 to LO
315.0	S1 to S2, S3 to HI, S4 to LO

j. Verify that each in-phase voltage reading is within the limits specified:

Angles 0, 90, 180, 270
limit: 0±2.268mV in-phase

Angles 45, 135, 225, 315
limit: 0±3.207mV in-phase

k. Program DUT to 11.8V L-L using the following command string:

DS1 VLL_VOLT 11.8

l. Repeat step (i) above.

m. Verify that each in-phase voltage reading is within the limits specified:

Angles 0, 90, 180, 270
limit: 0±1.029mV in-phase

Angles 45, 135, 225, 315
limit: 0±1.455mV in-phase

n. Program DUT to 2000Hz using the following command string:

REF_GEN1 FREQ 2000.00

o. Repeat step (i) above.

p. Verify that each in-phase voltage reading is within the limits specified:

Angles 0, 90, 180, 270
limit: 0±2.058mV in-phase

Angles 45, 135, 225, 315
limit: 0±2.910mV in-phase

q. Program DUT to 1.0V L-L and 6V Reference using the following command string:

DS1 VLL_VOLT 1.0
REF_GEN1 VOLT 6.0

r. Repeat step (i) above.

s. Verify that each in-phase voltage reading is within the limits specified:

Angles 0, 90, 180, 270
limit: 0±0.1745mV in-phase

Angles 45, 135, 225, 315
limit: 0±0.2468mV in-phase

Single-Speed Generation (Simulator) External Reference Checkout Procedure

a. Set up equipment as shown in Figure 3.

b. Program DUT using the following command strings:

DS1 REF_SOURCE EXT
DS1 REF_VOLT_IN 115.0
DS1 VLL_VOLT 90.0
DS1 MODE SYN
DS2 RATIO 1
DS1 STATE CLOSED

c. Turn on Model 5300 Reference Source and set reference output to Internal Reference, 47 Hz, 115V.

d. For each angle listed below, make connections to DAV SIG HI and SIG LO as shown. Program each specified angle using the **DS1 ANGLE<value>** command.

Angle	Connections
0.000	S3 to HI, S1 to LO
60.00	S3 to HI, S2 to LO
120.0	S1 to HI, S2 to LO
180.0	S1 to HI, S3 to LO
240.0	S3 to HI, S2 to LO
300.0	S1 to HI, S2 to LO

d. Verify that each in-phase voltage reading is within the limits specified:

limit: 0±23.56mV in-phase

e. Program DUT to Resolver mode, 400Hz, 26V L-L, 26V Reference using the following command string:

DS1 MODE RSL
DS1 VLL_VOLT 26.0

f. Set Model 5300 Reference Source to 400Hz.

g. For each angle listed below, make connections to DAV SIG HI and SIG LO as shown. Program each specified angle using the **DS1 ANGLE <value>** command.

Angle	Connections
0.000	S1 to S4, S3 to HI, S1 to LO
45.00	S1 to S4, S3 to HI, S2 to LO
90.00	S1 to S2, S2 to HI, S4 to LO
135.0	S1 to S2, S3 to HI, S4 to LO
180.0	S1 to S4, S3 to HI, S1 to LO
225.0	S1 to S4, S3 to HI, S2 to LO
270.0	S1 to S2, S2 to HI, S4 to LO
315.0	S1 to S2, S3 to HI, S4 to LO

h. Verify that each in-phase voltage reading is within the limits specified:

Angles 0, 90, 180, 270
limit: 0±2.268mV in-phase

Angles 45, 135, 225, 315
limit: 0±3.207mV in-phase

i. Program DUT to 11.8V L-L, 2000Hz using the following command string:

DS1 VLL_VOLT 11.8

j. Set Model 5300 Reference Source to 2000Hz.

k. Repeat step (g) above.

l. Verify that each in-phase voltage reading is within the limits specified:

Angles 0, 90, 180, 270
limit: 0±2.058mV in-phase

Angles 45, 135, 225, 315
limit: 0±2.910mV in-phase

Two-Speed Generation (Simulator) Checkout Procedure

a. Set up equipment as shown in Figure 4.

b. Program DUT using the following command strings:

DS1 REF_SOURCE INT
REF_GEN1 FREQ 400.00
REF_GEN1 VOLT 26.0
DS1 VLL_VOLT 11.8
DS2 VLL_VOLT 11.8
DS1 MODE RSL
DS2 MODE RSL
DS1 STATE CLOSED
DS2 STATE CLOSED
REF_GEN1 STATE CLOSE

c. Set DUT speed ratio to 2 with the following program string:

DS2 RATIO 2

d. For each angle listed below, read the 1X API and the NX API. Program each specified angle using the **DS1 ANGLE <value>** command.

Nominal Angle
0.000
45.00
90.00
135.0
180.0
225.0
270.0
315.0

e. Verify that each API reading is within the limits specified:

1X API
limit: ±45.0° from nominal

NX API
limit: 0±0.01° from nominal

f. Set DUT speed ratio to 15 with the following program string:

DS2 RATIO 15

g. Repeat step (d) above.

i. Verify that each API reading is within the limits specified:

1X API
limit: ±6.0° from nominal

NX API
limit: 0±0.075° from nominal

j. Set DUT speed ratio to 50 with the following program string:

DS2 RATIO 50

k. Repeat step (d) above.

l. Verify that each API reading is within the limits specified:

1X API
limit: ±1.8° from nominal

NX API
limit: 0±0.250° from nominal

Generation (Simulator) Angle Rate Checkout

a. Set up equipment as shown in Figure 5.

b. Program DUT using the following command strings:

DS1 REF_SOURCE INT
REF_GEN1 FREQ 400.00
REF_GEN1 VOLT 26.0
DS1 VLL_VOLT 11.8
DS1 MODE RSL
DS2 RATIO 1
DS1 ROT_RATE 360
DS1 ROT_MODE CONT
DS1 STATE CLOSED
REF_GEN1 STATE CLOSE
DS1 ROT_INIT

c. Set oscilloscope to 100mS per division.

d. Synchronize oscilloscope to display a sinusoidal envelope. Then envelope should go from zero, to full scale, and back to zero in 0.50 seconds. The display will show exactly 2 envelope waveforms.

Single-Speed Measurement (API) Internal Reference Checkout Procedure

a. Set up equipment as shown in Figure 6.

b. Program DUT using the following command strings:

SD1 REF_SOURCE INT
REF_GEN1 FREQ 400.00
REF_GEN1 VOLT 115.0
SD1 MODE SYN
SD1 STATE CLOSED
REF_GEN1 STATE CLOSE

c. Setup Model 5300 Simulator to External Reference, 400Hz, 90V L-L, Synchro mode. Press Model 5300 CAL button.

d. For each angle listed below, set the Model 5300 Simulator Output Angle, and read the DUT under test using the **SD1 ANGLE?** command.

Nominal Angle
0.000
45.00
90.00
135.0
180.0
225.0
270.0
315.0

e. Verify that all angle readings are within the following limit:

Limit: 0.0050°

f. Set Model 5300 to 26V Reference, 11.8V L-L, Resolver mode. Press Model 5300 CAL button.

g. Set DUT to 26V Reference, 11.8V L-L , Resolver mode with the following program string:

REF_GEN1 VOLT 26.0
SD1 MODE RSL

h. Repeat steps (d) through (e) above.

i. Set Model 5300 to 6V Reference, 1.0V L-L, 2000Hz. Press Model 5300 CAL button.

j. Set DUT to 6V Reference, 1.0V L-L, 2000Hz with the following program string:

REF_GEN1 VOLT 6.0
REF_GEN1 FREQ 2000.00

o. Repeat steps (d) through (e) above but use the following limits.

Limit: ±0.0240°

Single-Speed Measurement (API) External Reference Checkout Procedure

a. Set up equipment as shown in Figure 7.

b. Program DUT using the following command strings (Note, 47Hz test for 5395-F2 only):

SD1 REF_SOURCE EXT
SD1 MODE SYN
SD2 RATIO 1
SD1 STATE CLOSED

c. Setup Model 5300 Simulator to Internal Reference, 47Hz, 90V L-L, Synchro mode. Press Model 5300 CAL button.

d. For each angle listed below, set the Model 5300 Simulator Output Angle, and read the DUT under test using the **SD1 ANGLE?** command

Nominal Angle
0.000
45.00
90.00
135.0
180.0
225.0
270.0
315.0

e. Verify that all angle readings are within the following limit:

Limit: 0.0120°

f. Set Model 5300 to 26V L-L, Resolver mode. Press Model 5300 CAL button.

g. Set DUT to 400Hz, 26V Reference, 26V L-L, Resolver mode with the following program string:

REF_GEN1 STATE OPEN
SD1 MODE RSL

h. Repeat steps (d) through (e) above but use the following limits:

Limit: ±0.005°

i. Set Model 5300 to 11.8V L-L, 2000Hz. Press Model 5300 CAL button.

j. Repeat steps (d) through (e).

Two-Speed Measurement (API) Checkout Procedure

a. Set up equipment as shown in Figure 8.

b. Program DUT using the following command strings:

SD1 REF_SOURCE EXT
REF_GEN1 STATE OPEN
SD1 MODE RSL
SD2 MODE RSL
SD1 STATE CLOSED
REF_GEN1 STATE CLOSED

c. Setup Model 5300 Simulator #1 (connected to 1X outputs) to **Internal** Reference, 115V Reference, 400Hz, 90V L-L, Resolver. Press Model 5300 CAL button.

d. Setup Model 5300 Simulator #2 (connected to NX outputs) to **External** Reference, 90V L-L, Resolver. Press Model 5300 CAL button.

e. Program DUT to speed ratio of 2 using the following command string.

SD2 RATIO 2

f. For each angle listed below, set the Model 5300 Simulator #1 and Model 5300 Simulator #2 Output Angle, and read the DUT under test using the **SD1 ANGLE?** command.

Nominal Angle
0.000
45.00
90.00
135.0
180.0
225.0
270.0
315.0

g. Verify that each reading is within the following limit: ±0.003°

h. Program DUT to speed ratio of 15 using the following command string.

SD1 RATIO 15

i. Repeat step (f) and (g) above.

h. Program DUT to speed ratio of 16 using the following command string.

SD1 RATIO 16

i. Repeat step (f) and (g) above.

h. Program DUT to speed ratio of 50 using the following command string.

SD1 RATIO 50

i. Repeat step (f) and (g) above.

Generator (Simulator) DC Rate Output Checkout Procedure

a. Set up equipment as shown in Figure 9.

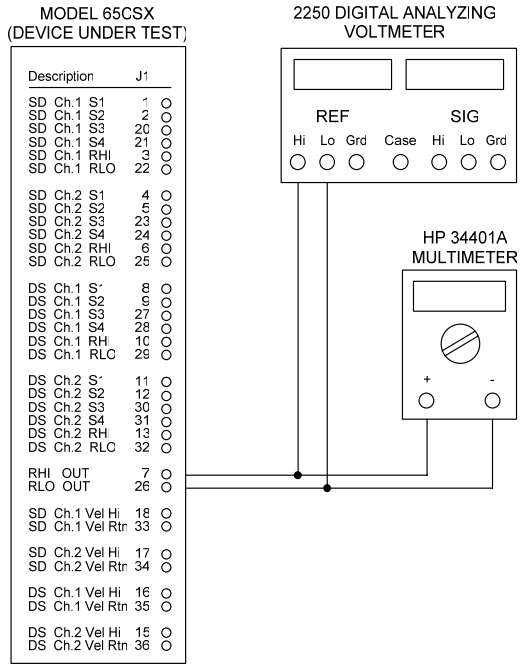
b. Program DUT using the following command strings:

DS1 REF_SOURCE INT
REF_GEN1 FREQ 400.00
REF_GEN1 VOLT 26.0
DS1 VLL_VOLT 11.8
DS1 MODE RSL
DS2 RATIO 1
DS1 ROT_RATE 500
DS1 ROT_MODE CONT
DS1 DC_SCALE 1000
SD1 STATE CLOSED
DS1 ROT_INIT

c. Setup DMM to read DC volts.

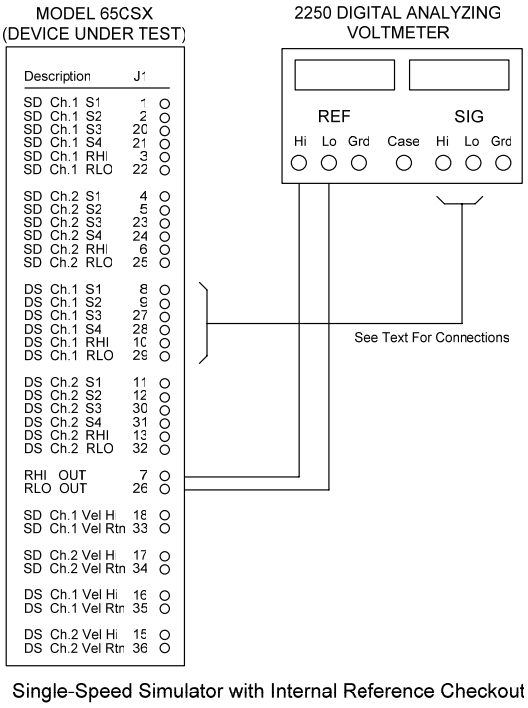
d. DMM should read nominal voltage of 5.00V DC.

Figures for Calibration Verification Test Set-up



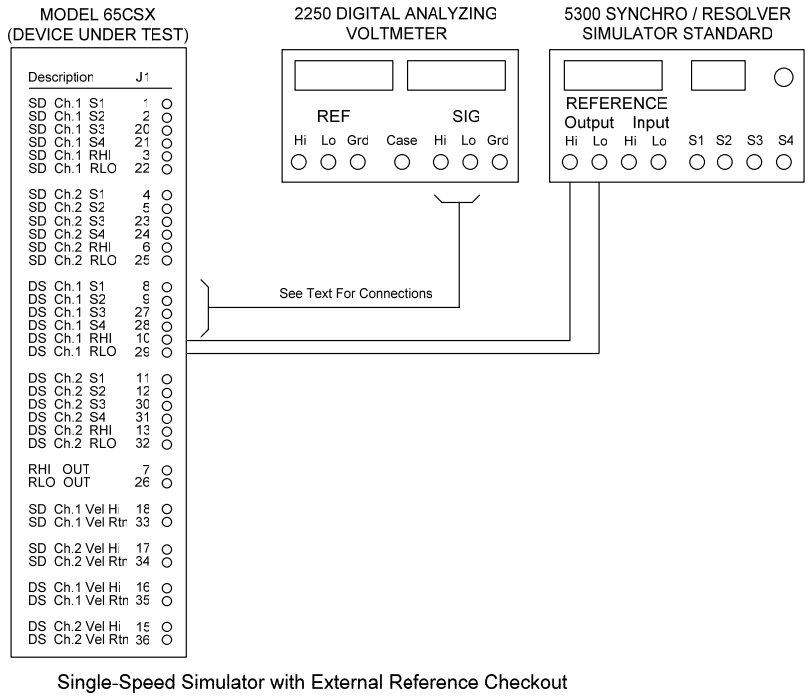
Internal Reference Checkout

Figure 1



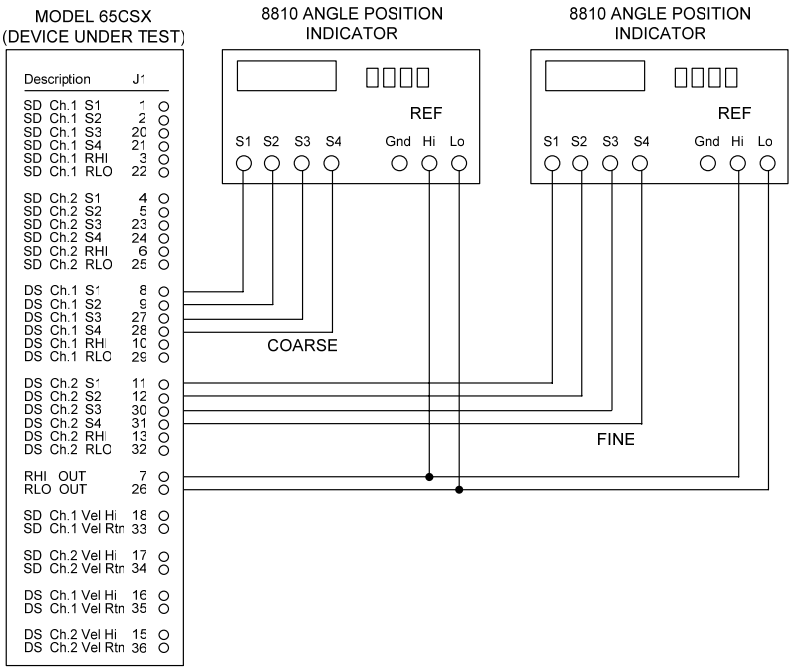
Single-Speed Simulator with Internal Reference Checkout

Figure 2



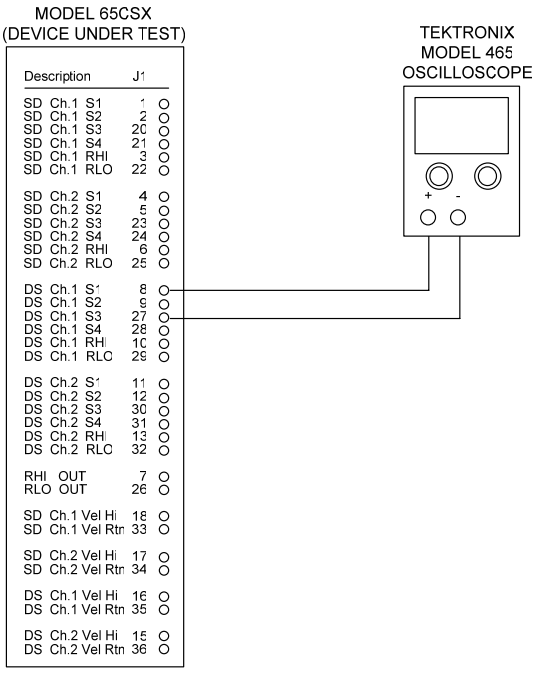
Single-Speed Simulator with External Reference Checkout

Figure 3



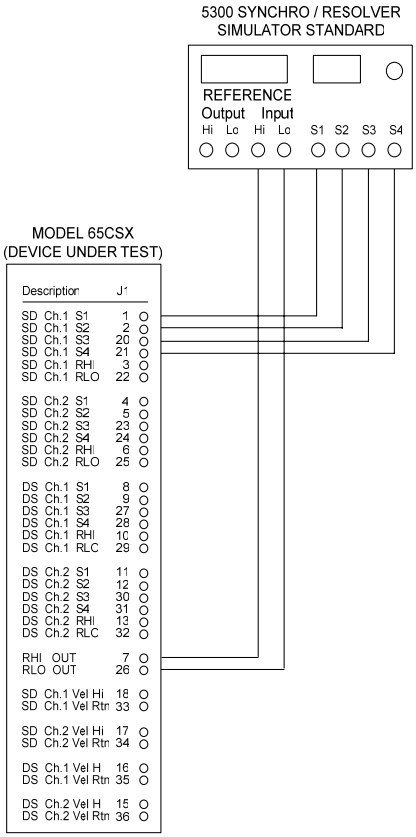
Two-Speed Simulator with Internal Reference Checkout

Figure 4



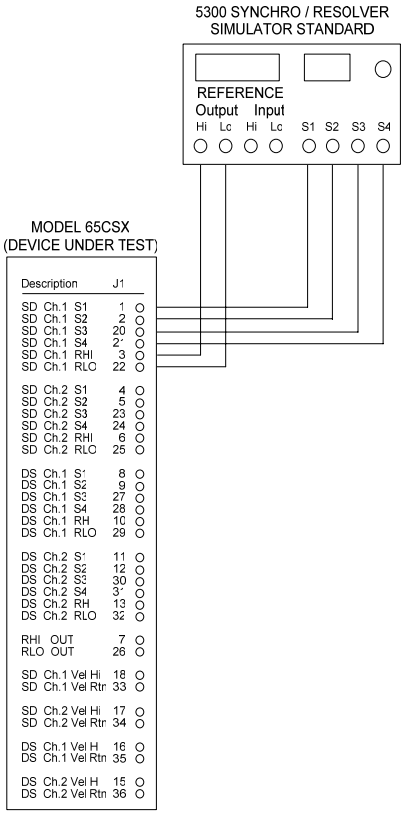
Simulator Angle Rate Checkout

Figure 5



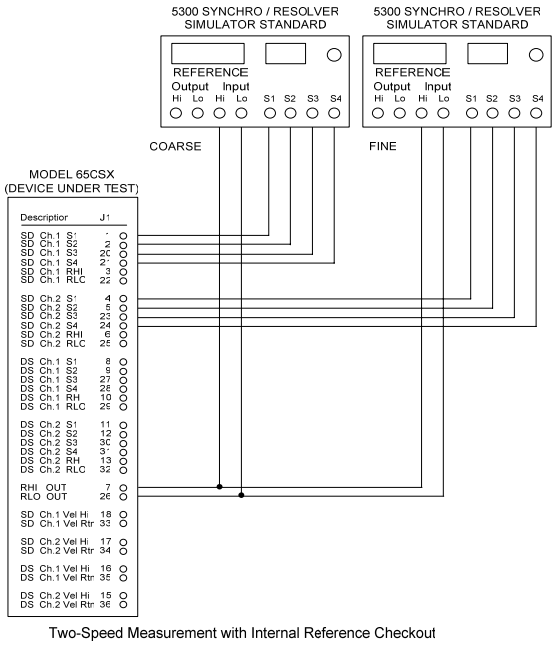
Single-Speed Measurement with Internal Reference Checkout

Figure 6



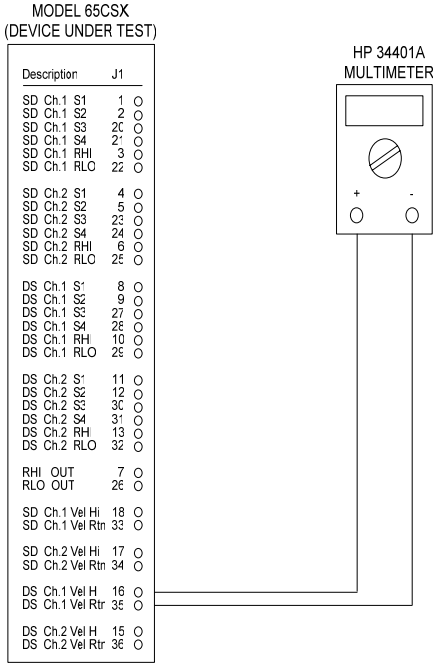
Single-Speed Measurement with External Reference Checkout

Figure 7



Two-Speed Measurement with Internal Reference Checkout

Figure 8



Simulator DC Rate Output Checkout

Figure 9

CONNECTOR CONFIGURATION

Connector Pin-out is dependant upon ordered card configuration (see part number).
Daughter Board #1 populates connector J1. Daughter Board #2 populates connector J2.
Instrument Grade connector has 37 pins. Conventional Grade connector has 78 pins.
Mating connectors are not supplied. Pin-out is sorted by Function

Instrument Grade Connector
DC37P. Mate DC37S or equivalent

PIN	DESCRIPTION		
1	SD Ch.1 S1		
2	SD Ch.1 S2		
20	SD Ch.1 S3		
21	SD Ch.1 S4		
3	SD Ch.1 RHI		
22	SD Ch.1 RLO		
4	SD Ch.2 S1		
5	SD Ch.2 S2		
23	SD Ch.2 S3		
24	SD Ch.2 S4		
6	SD Ch.2 RHI		
25	SD Ch.2 RLO		
8	DS Ch.1 S1	*	(RHI 3 Out)
9	DS Ch.1 S2	*	
27	DS Ch.1 S3	*	(RLO 3 Out)
28	DS Ch.1 S4	*	
10	DS Ch.1 RHI	*	
29	DS Ch.1 RLO	*	
11	DS Ch.2 S1	*	(RHI 2 Out)
12	DS Ch.2 S2	*	
30	DS Ch.2 S3	*	(RLO 2 Out)
31	DS Ch.2 S4	*	
13	DS Ch.2 RHI	*	
32	DS Ch.2 RLO	*	
7	RHI 1 OUT		
26	RLO 1 OUT		
18	SD Ch.1 Velocity Hi		
17	SD Ch.2 Velocity Hi		
16	DS Ch.1 Velocity Hi		
15	DS Ch.2 Velocity Hi		
33	SD Ch.1 Velocity Return		
34	SD Ch.2 Velocity Return		
35	DS Ch.1 Velocity Return		
36	DS Ch.2 Velocity Return		
19	Trigger -		
37	Trigger +		

Embedded Grade Connector
HDL78SLB Mate HDT78PD or equivalent

PIN	DESCRIPTION
4	DS Ch.1 S1
42	DS Ch.1 S2
3	DS Ch.1 S3
43	DS Ch.1 S4
22	DS Ch.1 RHI
61	DS Ch.1 RLO
6	DS Ch.2 S1
44	DS Ch.2 S2
5	DS Ch.2 S3
45	DS Ch.2 S4
24	DS Ch.2 RHI
63	DS Ch.2 RLO
8	DS Ch.3 S1
46	DS Ch.3 S2
7	DS Ch.3 S3
47	DS Ch.3 S4
26	DS Ch.3 RHI
65	DS Ch.3 RLO
10	DS Ch.4 S1
48	DS Ch.4 S2
9	DS Ch.4 S3
49	DS Ch.4 S4
28	DS Ch.4 RHI
67	DS Ch.4 RLO
12	DS Ch.5 S1
50	DS Ch.5 S2
11	DS Ch.5 S3
51	DS Ch.5 S4
30	DS Ch.5 RHI
69	DS Ch.5 RLO
14	DS Ch.6 S1
52	DS Ch.6 S2
13	DS Ch.6 S3
53	DS Ch.6 S4
32	DS Ch.6 RHI
71	DS Ch.6 RLO
16	DS Ch.7 S1
54	DS Ch.7 S2
15	DS Ch.7 S3
55	DS Ch.7 S4
34	DS Ch.7 RHI
73	DS Ch.7 RLO
18	DS Ch.8 S1
56	DS Ch.8 S2
17	DS Ch.8 S3
57	DS Ch.8 S4
36	DS Ch.8 RHI
75	DS Ch.8 RLO
59	RHI 2 OUT
20	RLO 2 OUT

* When a second and/or third reference supply is specified on an Instrument Grade daughter card, it replaces D/S channel 2 then 1 respectively and only rhi and rlo pins are active.
Do not connect to any undesignated pins.

PART NUMBER DESIGNATION

65CS4-XXXXXXX-XXXXXXX-X-XX

DAUGHTER BOARD #1
- AXXX0XX = Instrument Grade D/S, S/D and Reference
- BXXXXXX = Embedded Grade D/S and Reference
- Z000000 = no daughter board #1

DAUGHTER BOARD #2
- AXXX0XX = Instrument Grade D/S, S/D and Reference
- BXXXXXX = Embedded Grade D/S and Reference
- Z000000 = no daughter board #2

INTERFACE
- N = Native
- S = SCPI
- M = Mate CILL

CODE NUMBER

DAUGHTER BOARD CONFIGURATOR:

AXXX0XX = INSTRUMENT Grade S/D, D/S and Reference

- 0=2.2 VA; 1=5.2 VA Reference (available 2/06)
- FREQUENCY RANGE
  - A = 360 Hz to 2 KHz
  - B = 360 Hz to 4 KHz
  - C = 47 Hz to 2 KHz
  - D = 47 Hz to 4 KHz
  - E = 47 Hz to 10 KHz (contact factory)
  - F = 47 Hz to 20 KHz (contact factory)
- # of REFERENCE supplies (>2 consult factory)
- # of D/S channels
- # of S/D channels

BX X X X X X Embedded Grade D/S and Reference

- FREQUENCY RANGE
  - A = 360 Hz to 2 KHz
  - B = 360 Hz to 4 KHz
  - C = 47 Hz to 2 KHz
  - D = 47 Hz to 4 KHz
  - E = 47 Hz to 10 KHz (contact factory)
  - F = 47 Hz to 20 KHz (contact factory)
- Reference
  - 0 = no reference
  - 1 = low voltage (2-28 VAC rms)
  - 2 = high voltage (115 VAC rms)
- D/S #7 AND #8 (see D/S #1 and #2 below)
- D/S #5 AND #6 (see D/S #1 and #2 below)
- D/S #3 AND #4 (see D/S #1 and #2 below)
- D/S #1 AND #2
  - 0 = none
  - 1 = low voltage 2.2 VA — LOW VOLTAGE IS BETWEEN 2 TO 28 V L/L
  - 2 = high voltage 2.2 VA — HIGH VOLTAGE IS 90 V L/L

Example: Part Number **65CS4-A2210C0-B10000A** indicates:

65CS4 motherboard populated with;

1. Instrument grade daughter board 1; 2 S/D channels, 2 D/S channels, 1 2.2 VA Ref supply, 360-2Khz
2. Embedded grade daughter board 2; 2 D/S (channels1,2) (low voltage) only, 360-2KHz

REVISION HISTORY

Revision	Description of Change	Engineer	Date
2	Initial Release	FH	3/22/05
3	PN updated	GS	3/24/5
4	PN updated with Frequency Ranges	GS	3/31/5
4.1	Adds MODEL VXI- to Title. For consistency, used Converter Grade terminology through out.	GS	4/7/5
5.0	Resolver Measurement Input Voltage range is 1.0-90 VL-L (not 2-90)	GS	4/19/5
5.1	Maps J1 and J2 to Instrument and/or Conventional Grade Connector pin-out.	GS	5/12/5
5.2	Updates number of references	GS	6/20/5
5.3	Added continuous background calibration; 2.2 VA or 5.2 VA REF; corrected typos	FH/as	6/20/05
5.4	Re-structured; Added grade structure “H” and “L” for programming S/D and D/S modules	AS	01 Dec 05
5.5	Added notes; calibration test set-up (pg 17)	AS	26 Feb 06