

PRODUCT SPECIFICATION
for the
ST-220 6-CHANNEL RECIEVER SYSTEM

Release 1.0

Prepared by

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1.0 SYSTEM OVERVIEW..... 3

2.0 SYSTEM PERFORMANCE 5

 2.1 DEMODULATOR BER RATES 5

 2.2 DEMODULATOR ACQUISITION AND TRACKING PERFORMANCE..... 5

 2.3 REFERENCE..... 5

3.0 I/O SPECIFICATIONS (REAR PANEL CONNECTIONS) 6

 3.1 10 MHZ EXTERNAL REFERENCE INPUT 6

 3.2 10 MHZ EXTERNAL REFERENCE OUTPUT 6

 3.3 DEMODULATOR IF INPUTS..... 6

 3.4 IDATA/ QDAT AND CLOCK OUTPUTS* 6

 3.5 EXTERNAL TEST DATA AND CLOCK SOURCE (WITH ST-132 OPTION)..... 6

 3.6 CPU INTERFACES 6

4.0 BUILT IN TEST (OPTIONAL) 7

 4.1 OVERVIEW 7

5.0 ENVIRONMENTAL 8

6.0 SOFTWARE INTERFACE 8

 6.1 OPERATING SYSTEM 8

 6.2 PARAMETER ENTRY 8

 6.3 DISPLAYS 9

 6.4 BITE 9

 7.0 QUALIFICATION MATRIX 9

1.0 System Overview

The ST-220 is a six channel VME based receiver and demodulator. A top level diagram of the system is shown in Figure 1.0.

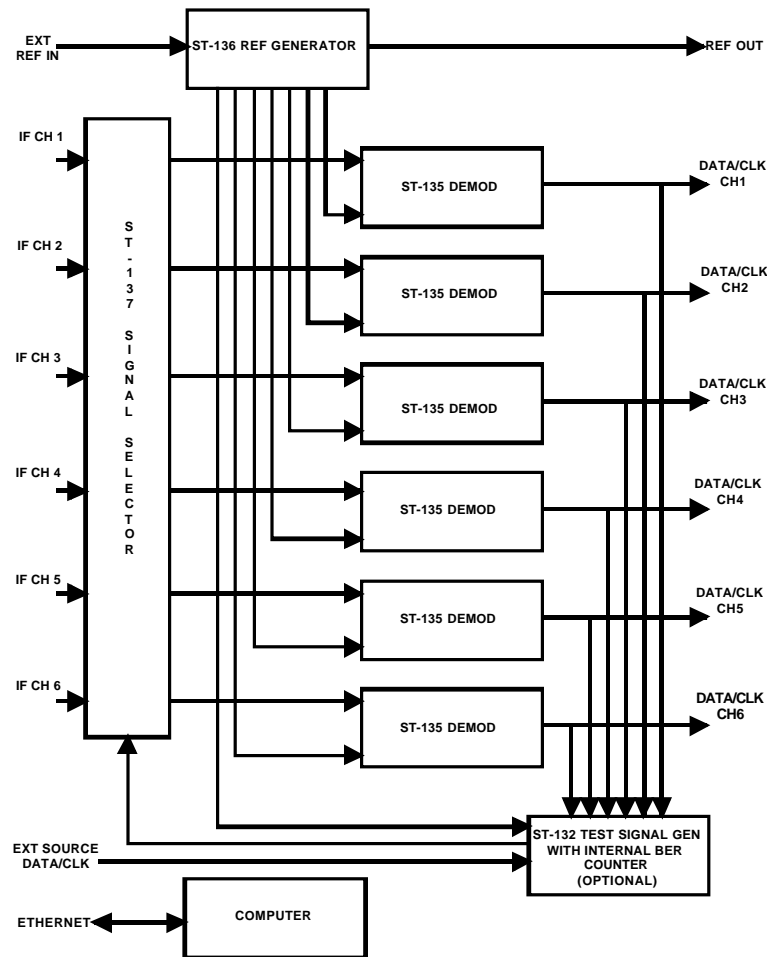


Figure 1.0 ST-212 Block Diagram

Six IF signals, in the frequency range of 45 to 200 MHz, may be input into the ST-220 for demodulation. These signals first pass through the ST-137, a selector board to allow test signal injection when desired. In addition, the ST-136 reference generator

provides a coherent reference to each of the ST-135 demodulators and to the optional ST-132 test signal generator. Each ST-135 demodulator outputs the recovered serial bit stream at RS-422 levels. The types of modulation processed include BPSK, DBPSK, QPSK, DQPSK, SQPSK, FSK, and MSK.

The optional ST-132 signal generator aids in system self test and diagnostics. The ST-132 includes a calibrated noise source and bit-error-rate (BER) test capability to allow measurement of each channel's BER performance with an accuracy of +/- 0.5 dB. The BER testing can be automated to allow system verification and characterization without human intervention. In addition, the system can be user controlled to allow single or multiple channel performance verification non-invasive to the operation of the remaining channels.

The ST-132 outputs the modulated data onto a fixed 70 MHz carrier. A 140 MHz version is also available. This test board is the only board in the ST-220 system that does not operate over the entire 45 MHz to 200 MHz carrier range.

A JAVA based GUI is provided to allow control of the ST-220 via TCP/IP. The GUI may also be run locally by connecting a keyboard, mouse, and monitor to the appropriate rear panel connectors. Control software, running on the ST-220 CPU board, both configures and controls the boards over TCP/IP. The TCP/IP interface is defined in Sigtek document 001-0220-601. The ST-220 Users Manual, documenting setup and operation, is Sigtek document 001-0220-602.

In order to facilitate software upgrades and maintenance, a CD-ROM drive is accessible from the unit front panel. Software updates will be delivered on CD-ROM.

2.0 System Performance

2.1 Demodulator BER Rates

2.1.1 BPSK Rates:	1.2 k to 14 M symbols/sec
2.1.2 BPSK Eb/No 1e-6 BER:	≤ 12.6 dB
2.1.3 DBPSK Rates:	1.2 k to 14 M symbols/sec
2.1.4 DBPSK Eb/No 1e-6 BER:	≤ 14.6 dB
2.1.5 (S)QPSK Rates:	1.2 k to 14 M symbols/sec
2.1.6 (S)QPSK Eb/No 1e-6 BER:	≤ 12.6 dB
2.1.7 DQPSK Rates:	1.2 k to 14 M symbols/sec
2.1.8 DQPSK Eb/No 1e-6 BER:	≤ 14.6 dB
2.1.9 FSK Rates:	1.2 k to 500k symbols/sec
2.1.10 FSK Eb/No 1e-6 BER:	≤ 18.6 dB
2.1.11 MSK Rates:	1.2 k to 500k symbols/sec
2.1.12 MSK Eb/No 1e-6 BER:	≤ 18.5 dB

2.2 Demodulator Acquisition and Tracking Performance

2.2.1 Carrier Acquisition:	$\pm 25\%$ of symbol rate
2.2.2 Symbol Acquisition:	$\pm 0.2\%$ of symbol rate
2.2.3 Doppler Tracking:	≤ 5 kHz/min (symbol rate ≥ 2.4 kpsps)
2.2.4 Doppler Tracking Range:	$\leq \pm 300$ kHz
2.2.5 Acquisition Time(≥ 1 Msps):	≤ 2 seconds (6 of 10 trials)
2.2.6 Acquisition Time(< 1 Msps):	≤ 5 seconds (6 of 10 trials)

2.3 Reference

2.3.1 Output Frequency:	10.000000 MHz
2.3.2 Accuracy:	± 1.0 Hz (10° C – 35° C)
2.3.3 Aging:	± 5.0 Hz per year
2.2.4 Phase noise:	-90 dBc at 10 Hz -110 dBc at 100Hz -120 dBc at 1 KHz -125 dBc at 10 KHz -130 dBc at 100KHz

3.0 I/O Specifications (Rear Panel Connections)

3.1 10 MHz External Reference Input

- 3.1.1 Connector: BNC
- 3.1.2 Impedance: 50 Ω nominal
- 3.1.3 Signal: sinewave or squarewave
- 3.1.4 Level: -8.0 to +8.0 dBm
- 3.1.5 Maximum Level: $\leq +10$ dBm

3.2 10 MHz External Reference Output

- 3.2.1 Connector: BNC
- 3.2.2 Impedance: 50 Ω nominal
- 3.2.3 Signal: AC coupled sinewave
- 3.2.4 Level: -3.0 to +3.0 dBm

3.3 Demodulator IF Inputs

- 3.3.1 Center Frequency: 45 to 200 MHz
- 3.3.2 Connector: BNC
- 3.3.3 Impedance: 50 Ω nominal
- 3.3.4 Power Level: -60 to -10 dBm

3.4 IDATA / QDAT and Clock Outputs

- 3.4.1 Signaling: RS-422
- 3.4.2 Connector: Twinax
- 3.4.3 Clock Polarity: invert/non-invert via software
- 3.4.4 (S)QPSK Data Format both I and Q or interleaved on I

3.5 External Test Data and Clock Source (with ST-132 Option)

- 3.5.1 Signaling: RS-422 Data Input, RS-422 Clock OUT
- 3.5.2 Connector: Twinax
- 3.5.3 Bit Rate Range: 1200 Hz to 1.0 MHz (modulate BPSK)
2400 Hz to 2.0 MHz (modulate QPSK)

3.6 CPU Interfaces

- 3.6.1 Video Display Output: SVGA (female)
- 3.6.2 Keyboard: PS/2
- 3.6.3 MOUSE: PS/2

3.6.4 Ethernet Interface:

Format:	10BaseT - Unshielded Twisted Pair
Connector:	RJ45

4.0 Built in Test (Optional)

4.1 Overview

The ST-220 has an optional Built in Test (BIT) capability. When BIT capability is desired, the system must include the ST-132 Test Generator with internal BER counter. All other required hardware is included within the base system. The complete BIT capability is as follows:

4.1.1 RF output:	70 MHz (140 MHz optional)
4.1.2 Internal Modulation:	BPSK, (S)QPSK, FSK, MSK
4.1.3 External Data:	BPSK, QPSK, FSK
4.1.4 Symbol Rate:	BPSK, (S)QPSK: 1.2 k to 1 M symbols/sec FSK, MSK: 1.2 k to 500 k symbols/sec
4.1.5 Eb/No Accuracy:	+/- 0.5 dB

The ST-220 executes BIT at power up. BIT consists of measuring the performance of each demodulator at 12.5 db Eb/No using QPSK modulation with a symbol rate of 1 M symbols/sec.

The test modulator can also be used via the GUI control interface to measure performance of any system modulation type. The test modulator can also accept an external data source for BPSK, QPSK and FSK modulation.

BIT is implemented using the (optional) ST-132 Signal Generator and the ST-137 Signal Selector. The ST-132 generates the test signal which is then cabled to the ST-137 for distribution. The ST-137 splits the incoming test signal and drives an image to each of six switches for distribution to the respective ST-135 demodulators.

Selection is under ST-220 CPU control. The digital output of each demodulator is returned to the ST-132, via the VME P2, for BER calculation. A multiplexer within the ST-132 selects the desired demodulator data for the calculation.

5.0 Environmental

- 5.1 Power: 120/240 \pm 10%, 47 – 63 Hz, 750 Watts max.
- 5.2 Ambient Temperature: 10° C – 35° C
- 5.3 Weight: 75 lbs.
- 5.4 Size: 19" W x 14.0" H x 20" D

6.0 Software Interface

Three levels of software interface are provided. The first is a set of low level TCP/IP commands to control the configuration of the ST-220. The TCP/IP ICD is defined in Sigtek document 001-0220-601.

The next two levels of interface are graphical user interfaces (GUI). Two nearly identical interfaces are supplied. The first runs on the local VME controller contained in the ST-220. This interface is accessed by connecting a monitor, keyboard, and mouse to the rear panel connectors on the ST-220 chassis. The other GUI is a TCP/IP based GUI which runs on a remote machine, which is JAVA based and platform independent. Sigtek will supply a source code license for the TCP/IP GUI so that the customer can modify the software as necessary for custom ST-220 applications.

System Software Specifications:

6.1 Operating System

6.1.1 Windows NT

6.2 Parameter Entry

6.2.1 Modulation Type: Pull Down Menu

6.2.2 Carrier Frequency: Numeric Entry (referenced to RF input range)

- 6.2.3 Symbol Rate: Numeric Entry
 6.2.4 Carrier Loop BW: Numeric Entry (Initial estimate provided)
 6.2.5 Symbol Loop BW: Numeric Entry (Initial estimate provided)

6.3 Displays

- 6.3.1 Carrier Lock: Green locked
 6.3.2 Symbol Lock: Green locked
 6.3.3 Constellation: Resizeable graphic

6.4 BITE

- 6.4.1 Modulation Type: Pull Down Menu
 6.4.2 Carrier Frequency: Numeric Entry (referenced to RF range)
 6.4.3 Symbol Rate: Numeric Entry
 6.4.4 Plot: Eb/No vs. BER (specification reference provided)

7.0 Qualification Matrix

The testing of the ST-220 must conform to the qualification matrix provided below. Within the matrix the test type specifies if the test is a one-time design verification test (DV) or a production acceptance test (Acc). During design verification testing all test are run, DV and Acc, during production testing only the Acc tests are run. A production acceptance test is run on every unit. The method specifies the level of test required for each specification. Possible methods are:

T = a test or set of tests is required, judgement is used to limit the number of tests
 SST = the required specification is specific to one assembly in the system and is tested at the subsystem level, SST-1 refers to the ST-135 Demodulator
 I = a visual inspection is required
 A = Analysis and/or verification via a data sheet of the associated subsystem is required

Paragraph Number	Title	Method	Type
2.1.1	BPSK Rates	T, SST-1	Acc

2.1.2	BPSK Eb/No 1e-6 BER	T, SST-1	Acc
2.1.3	DBPSK Rates	T, SST-1	Acc
2.1.4	DBPSK Eb/No 1e-6 BER	T, SST-1	Acc
2.1.5	(S)QPSK Rates	T, SST-1	Acc
2.1.6	(S)QPSK Eb/No 1e-6 BER	T, SST-1	Acc
2.1.7	DQPSK Rates	T, SST-1	Acc
2.1.8	DQPSK Eb/No 1e-6 BER	T, SST-1	Acc
2.1.9	FSK Rates	T, SST-1	Acc
2.1.10	FSK Eb/No 1e-6 BER	T, SST-1	Acc
2.1.11	MSK Rates	T, SST-1	Acc
2.1.12	MSK Eb/No 1e-6 BER	T, SST-1	Acc
2.2.1	Carrier Acquisition	SST-1	NA
2.2.2	Symbol Acquisition	SST-1	NA
2.2.3	Doppler Tracking	SST-1	NA
2.2.4	Acquisition Time(≥ 1 Msps)	SST-1	NA
2.2.5	Acquisition Time(< 1 Msps)	SST-1	NA
2.2.6	Doppler Tracking Range	SST	NA
3.1.1	Output Frequency	T	Acc
3.1.2	Accuracy	T	Acc
3.1.3	Aging	A	DV
3.1.4	Phase Noise	A	DV
3.1.5	Maximum Level	A	DV
3.2.1	Connector	I	DV
3.2.2	Impedance	A	DV
3.2.3	Signal	I	Acc
3.2.4	Level	T	Acc
3.3.1	Center Frequency	T	Acc
3.3.2	Connector	I	DV
3.3.3	Impedance	A	DV
3.3.4	Power Level	T	Acc
3.4.1	Signaling	T	Acc
3.4.2	Connector	I	DV
3.4.3	Clock Polarity	T	DV
3.4.4	(S)QPSK Data Format	T	DV
3.5.1	Signaling	T	Acc
3.5.2	Connector	I	DV
3.5.3	Bit Rate Range	T	Acc
3.6.1	Video Display Output	T	Acc
3.6.2	Keyboard	T	Acc
3.6.3	Mouse	T	Acc
3.6.4	Ethernet Interface	T	Acc

4.1.1	RF Output	T (W/ST132 Option)	Acc
4.1.2	Internal Modulation	T (W/ST132 Option)	Acc
4.1.3	External Data	T (W/ST132 Option)	Acc
4.1.4	Symbol Rate	T (W/ST132 Option)	Acc
4.1.5	Eb/No Accuracy	T (W/ST132 Option)	Acc
5.1	Power	A	DV
5.2	Ambient Temperature	T	DV
5.3	Weight	T	DV
5.4	Size	T	DV
6.1.1	Windows NT	I	DV
6.2.1	Modulation Type	I	DV
6.2.2	Carrier Frequency	I	DV
6.2.3	Symbol Rate	I	DV
6.2.4	Carrier Loop BW	I	DV
6.2.5	Symbol Loop BW	I	DV
6.3.1	Carrier Lock	T	Acc
6.3.2	Symbol Lock	T	Acc
6.3.3	Constellation	T	Acc
6.4.1	Modulation Type	I	DV
6.4.2	Carrier Frequency	I	DV
6.4.3	Symbol Rate	I	DV
6.4.4	Plot	T	Acc

<i>Change Number</i>	<i>Date of Change</i>	<i>Authorization of Change</i>	<i>Description (pages)</i>