SCRAMNet® Network

Skew Meter

Owner's Manual

Document No. D-T-MU-SKEWMTR#-A-0-A2

FOREWORD

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SYSTRAN Corporation
4126 Linden Avenue
Dayton, OH 45432-3068 USA
(937) 252-5601

FCC

This product is intended for use in industrial, laboratory or military environments. This product uses and emits electromagnetic radiation which may interfere with other radio and communication devices. The user may be in violation of FCC regulations if this device is used in other than the intended market environments.

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1.0 INTRODUCTION

1.1 Overview

This manual describes how to use the SCRAMNet+ Skew meter to measure and minimize the skew in the paired conductors within each cable of your SCRAMNet+ network.

SCRAMNet+ (Shared Common Random Access Memory Network) is a communications network geared toward real-time applications, and based on a replicated, shared-memory concept.

SCRAMNet uses a pair of fiber-optic or coaxial conductors to transmit its data from one node to another. For reliable data recovery by the receiver, the difference in accumulated delay, or skew, of the two signal paths between active SCRAMNet nodes must be less than 1 nanosecond. (An active node is one in which neither wire loopback nor optic loopback is active). Cable manufacturing tolerances may cause an unacceptable amount of skew in longer cable runs, even if the cables are equal in physical length. The SCRAMNet+ Skew Meter can be used to measure the skew of the paired conductors and determine what corrective action, if any, must be taken to bring it within limits.

1.2 Features

The SCRAMNet+ Skew Meter has the following features:

- Measures skew in fiber or coax paired conductors of a cable, depending on the type of media card installed in the meter.
- Measures skews up to 120 ns (approximately 24 meters).
- Power requirement: 5VDC at 1A. A line-powered external supply is provided.

1.3 Technical Support

Technical documentation provided with the Skew Meter discusses technology and performance characteristics. SYSTRAN also publishes technical briefs and application notes that cover a wide assortment of topics. The applications selected are derived from real scenarios.

Direct any programming questions, any concerns about the functionality of this meter for your particular application, or any questions not answered satisfactorily by this document, to the factory by phone, or send an E-mail message to **support@systran.com**.

1.4 Reliability

SYSTRAN corporate policy is to provide the highest quality products in support of customer needs. In addition to the physical product, SYSTRAN provides documentation, sales and marketing support, hardware and software technical support, and timely product delivery. The SYSTRAN commitment to quality begins with product concept, and continues after receipt of the purchased product.

SYSTRAN has developed a quality system which conforms to the ISO 9001 international standard for quality systems. ISO 9001 is the model for quality assurance in design, development, production, installation and servicing. The ISO 9001 standard is the most comprehensive of the conformance standards, in that it addresses all 20 clauses of the ISO quality system requirements.

SYSTRAN's quality system addresses the following basic quality objectives:

- Achieve, maintain and continually improve the quality of SYSTRAN products
- Improve the quality of its own operations to meet the needs of SYSTRAN customers and stakeholders
- Provide confidence internally that quality is being fulfilled, maintained and improved
- Provide confidence to the customer and other stakeholders that requirements for quality will be achieved in the delivered product

SYSTRAN's quality system was assessed by BSI QA, which is the certification division of British Standards Institution, the largest and most respected standardization authority in the world. SYSTRAN's quality system was found to meet or to exceed the international standards in all areas, and Certificate of Registration number FM 31468 was issued to SYSTRAN on May 16, 1995.

The scope of SYSTRAN's registration is: "Design, manufacture, and service of high technology hardware and software computer communications products." The registration is maintained under BSI QA's program of continuing assessment, under which an audit of the quality system is performed by BSI QA every six months.

Customer feedback is an integral part of meeting SYSTRAN quality and reliability goals. Customers are encouraged to contact the factory with any questions or suggestions regarding unique quality requirements, or to obtain additional information about our programs. SYSTRAN's commitment to customers includes, but is not limited to the following:

- Professional and quick response to customer problems using SYSTRAN's extensive resources.
- Incorporation of established procedures for product design, test, and production operations, with documented milestones. Procedures are constantly reviewed and improved, ensuring the highest possible quality.

SYSTRAN provides products and services that meet or exceed the best expectations of our customers.

- All products receive a predictive reliability rating based upon a calculated MTBF (Mean Time Between Failure) using the MIL-HDBK-217F. Field failures are continuously logged and evaluated for potential failure modes and trends.
- Other environmental parameters are guaranteed by design, and are not tested.

Design reliability is ensured by methodology (top-down CAE design, VHDL, synthesis, extensive all-cases simulation, ALPHA build and test, and BETA testing, if required) with full concurrent engineering practices throughout.

1.5 Related Documentation

SCRAMNet Network Media User's Guide, Systran document number D-T-MU-MEDIA.

1.6 Ordering Process

To learn more about SYSTRAN products or about custom-designed boards, or to place an order, the following contacts are available:

- Phone: **(937) 252-5601**
- E-mail address: **info@systran.com**
- World Wide Web address: **http://www.systran.com**

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2.0 DESCRIPTION

2.1 Overview

The Skew Meter measures the skew of a paired-conductors SCRAMNet cable by generating two signals with a known phase relationship and driving them into one end of the cable. At the other end of the cable the two signals are compared and the change in the phase relationship is used to determine the propagation skew between the two elements of the pair. The only equipment needed to measure the skew is the Skew Meter, its power supply, and the cable to be tested.

If both ends of the cable are not close enough to each other to plug into a single Skew Meter, two Skew Meters may be used, one to generate and transmit the signals and the other to receive and measure them.

The Skew Meter can be supplied with a SCRAMNet+ Long-Link, Standard-Link, or Coax-media interface. The Long-Link interface is the most likely to be used, since skew tends to be more of a problem when long cable lengths are used.

2.2 Connections

The cable to be tested connects between the two transmit media connectors, TXA and TXB, and the two receive media connectors, RXA and RXB. These are fiber-optic ST connectors or copper SMA connectors, depending upon which media interface is installed.

5 VDC power must be provided to the meter through the power jack. An external power supply is provided so that the meter can be powered from AC wall-outlet power (100 - 240 VAC, 50/60 Hz). If this power supply cannot be used for some reason, any other source of 5 VDC at about 1 A may be used. See Appendix A for information on providing an alternate power source.

2.3 Controls

Power (On/Off) and Range (±12.00 ns / ±120.0 ns) toggle switches are on the front panel.

2.4 Indicators

Two green LEDs near the RXA and RXB inputs indicate that a signal is detected at the associated input.

A yellow "SWAP" LED indicates that the conductor pair is cross-connected so that TXA drives RXB and TXB drives RXA. If this light is on the connections should be swapped at one end so that the meter correctly indicates which conductor is shorter.

The numerical display shows the amount of skew in nanoseconds. It will display a positive number if conductor A (connecting TXA to RXA) is longer than conductor B (connecting TXB to RXB) and a negative number if conductor B is longer.

☞ **NOTE**: **The display cannot indicate that the skew is out of range**, because the meter has no way to detect this condition. Therefore the ±120.0 ns range should always be checked to make sure the skew is small enough before taking a reading with the ±12.00 ns range.

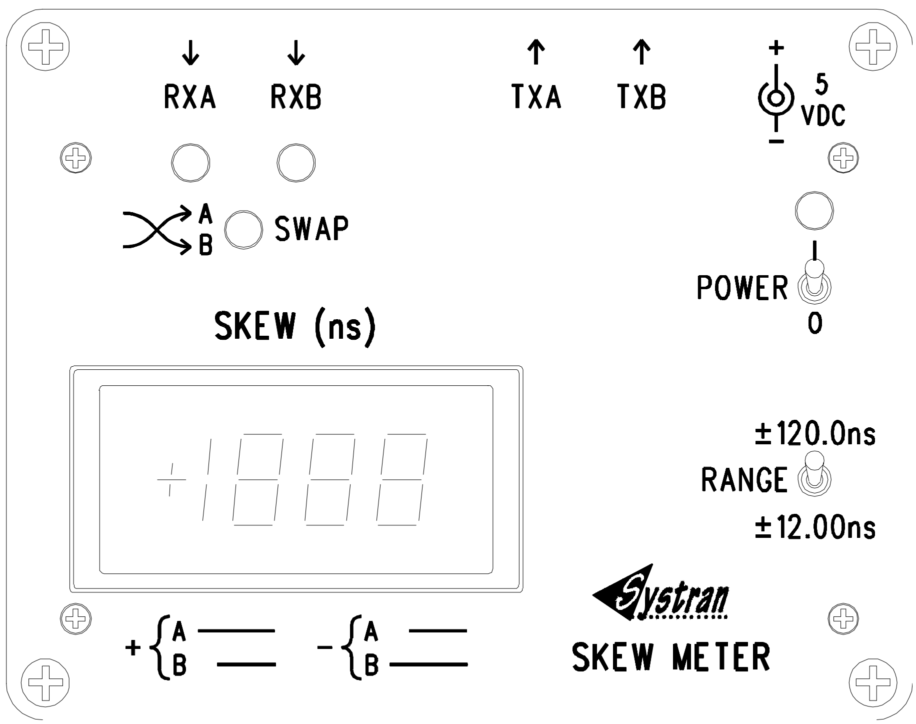

Figure 2-1 Skew Meter Face Plate

3.0 OPERATION

3.1 Single-meter operation

To measure the skew in a cable when both ends of the cable can be plugged into the same Skew Meter, perform the following steps:

1. Apply power to the meter with the supply that came with the meter or from some alternative source. (See Appendix A for information on providing an alternate power source).
2. Connect one end of the cable to be tested to the TXA and TXB connectors, and the other end to the RXA and RXB connectors.
3. Turn the Power switch on and set the Range switch to "±120.0 ns".
4. Both green signal detect LEDs should be lit. A dark LED means that the associated RX input isn't receiving a signal.
5. If the yellow "SWAP" LED is lit, swap the cable connections at either TXA-TXB or RXA-RXB. This ensures that the conductors are connected TXA to RXA and TXB to RXB.
6. Read the amount of skew in nanoseconds from the display. If the absolute value of the reading is less than 12 nanoseconds, set the Range switch to "±12.00 ns" for better resolution. A positive reading indicates that conductor A (connecting TXA to RXA) is longer than conductor B (connecting TXB to RXB). A negative reading indicates that conductor B is longer.

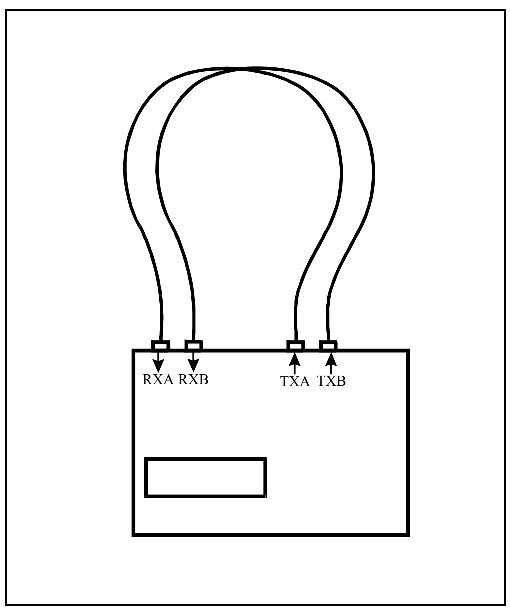

Figure 3-1 Connecting the cable for single-meter operation

3.2 Two-meter operation

If the ends of the cable are physically separated and can't be plugged into a single skew meter, the skew of the pair can still be measured by using two skew meters, one as a transmitter and one as a receiver.

Measure the offset between the two meters first.

1. Choose one meter to be the transmitter ("Meter 1") and one to be the receiver ("Meter 2").
2. Apply power to both meters with the supplies that came with them or from some alternative source. (See Appendix A for information on providing an alternative power source.)
3. Connect short, equal-length conductors as shown in Figure 3-2. Turn on the Power switches of both meters and set both Range switches to "±120.0 ns".
4. Both of Meter 2's green signal detect LEDs should be lit. A dark LED means that the associated RX input isn't receiving a signal. (The LEDs and display of Meter 1 are ignored in the two-meter setup.)
5. Record the number indicated on Meter 2's display. This is the offset for the ±120.0 ns range.
6. Set both Range switches to "±12.00 ns". Record the number indicated on Meter 2's display. This is the offset for the ±12.00 ns range.

To make a skew measurement:

1. Apply power to both meters with the supplies that came with them or from some alternative source.
2. Connect one end of the cable to be tested to the TXA and TXB connectors on Meter 1. Turn on Meter 1's Power switch and set its Range switch to "±120.0 ns".
3. Connect the other end of the cable pair to the RXA and RXB connectors of Meter 2. Turn on Meter 2's power switch and set the Range switch to "±120.0 ns".
4. Both of Meter 2's green signal detect LEDs should be lit. A dark LED means that the associated RX input isn't receiving a signal.
5. If Meter 2's yellow "SWAP" LED is lit, swap the cable connections at either TXA-TXB or RXA-RXB. This ensures that the conductors are connected TXA to RXA and TXB to RXB.
6. Take the number on Meter 2's display and subtract the offset you recorded for the ±120.0 ns range. This is the measured skew in nanoseconds.
7. If the absolute value of the number on Meter 2's display is less than 12 nanoseconds, set the Range switch **of both meters** to "±12.00 ns" for better resolution. Subtract the offset you recorded for the ±12.00 ns range from the number on Meter 2's display to get the measured skew.
8. A positive reading indicates that conductor A (connecting TXA to RXA) is longer than conductor B (connecting TXB to RXB). A negative reading indicates that conductor B is longer.

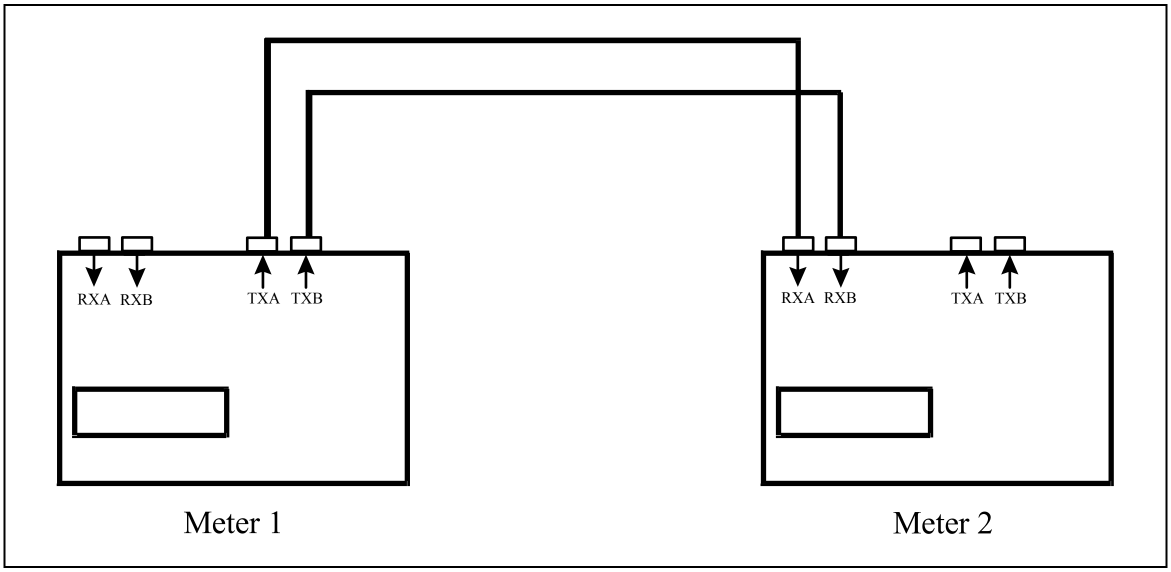

Figure 3-2 Connecting the cables for two-meter operation

> **NOTE**: To avoid confusion, both RANGE switches *must be in the same position!* The RANGE switch on Meter 1 controls the actual measurement range, but the RANGE switch on Meter 2 controls the decimal point on Meter 2's display.

3.3 Notes on Operation

- The rightmost digit of the display will drift with time and temperature and can safely be ignored.
- Allowing the meter to warm up for five minutes or so before taking a reading will bypass the worst of the temperature drift.
- It is normal for the meter to feel warm in operation, especially near the TX connectors.

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4.0 ADJUSTING THE SKEW

4.1 How to adjust the skew

Once you have measured the amount of skew in a cable, you can adjust the skew toward zero either by cutting off a piece of the longer conductor and installing a new connector or by connecting a short extender to the shorter conductor.

4.1.1 Adjusting the Skew:

If a short extender is needed, fiber optic extender cables are available in lengths in multiples of 5 cm (~ 2 in). By using the Skew to length conversion Table 4-1, the appropriate length can be ordered. The part number for the fiber optic extender cable is: H-PR-WST1XXXX-0

The "XXXX" section of the order number represents the length of the fiber optic extender cable ordered. See Table 4-2 for examples of order numbers for the fiber optic extender cable.

Table 4-1 Examples of fiber optic extender cable order numbers

CABLE LENGTH	ORDER NUMBER
5 cm (~ 2 in)	H-PR-WST105R0-0
10 cm (~ 4 in)	H-PR-WST110R0-0
1 m (~ 3.28 ft)	H-PR-WST11000-0

The conversion from nanoseconds to length to be added or subtracted depends on the signal propagation speed of your particular cable. For many cables, including Systran's, the propagation speed is almost exactly 20 cm/ns (7.9 in/ns). If you don't know the propagation speed of your cable, you can measure it by inserting a short known length into one side of a cable pair and measuring how much the skew changes.

Table 4-2 Conversion from nanoseconds of skew to cable length

Skew (ns)	Length (cm)	Length (in)
0.5	10	3.95
1.0	20	7.90
1.5	30	11.85
2.0	40	15.80
2.5	50	19.75
3.0	60	23.70
3.5	70	27.65
4.0	80	31.60
4.5	90	35.55
5.0	100	39.50
5.5	110	43.45
6.0	120	47.40
6.5	130	51.35
7.0	140	55.30
7.5	150	59.25
8.0	160	63.20
8.5	170	67.15
9.0	180	71.10
9.5	190	75.05
10.0	200	79.00

APPENDIX A
SPECIFICATIONS

A.1 Specifications

Physical Dimensions:	4.68 x 3.68 x 2.21 inches
Storage Temperature Range:	-40° to +70° C
Operating Temperature Range:	0° to 40° C
Storage Humidity Range:	5% to 95% (noncondensing)
Operating Humidity Range:	10% to 90% (noncondensing)
Power Requirements:	1 A at 5±5% VDC
Power connector:	Hollow-center power plug, 5.5 mm o.d., 2.5 mm i.d., 9.5 mm long, Switchcraft part number 760 or equivalent. The center conductor is positive.
Internal fuse:	Littelfuse part number R451002 (Systran part number AHPRF125V/2AS0A1)

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APPENDIX B:
CALIBRATION PROCEDURE

B.1 Calibration Procedure

Calibration of the Skew Meter is normally handled at the factory; however, if necessary the meter can be calibrated as follows:

1. Apply power to the meter and allow it to warm up.
2. Find a pair of short, equal-length conductors and a single conductor with a known delay. Note that the delay through an optical fiber may vary with wavelength, so the single conductor should have been measured at the same wavelength as is used by the meter that you're calibrating.
3. Remove power and open the meter case, then re-apply power to the opened meter. Throughout the following try to keep the meter at as constant a temperature as possible.
4. Connect the equal-length cables from TXA to RXA and from TXB to RXB. Note that both signal detect LEDs are lit and the "Swap Inputs" LED is dark.
5. Switch RANGE to "±120.0 ns". Adjust trimpot R501 so that the display reads 00.0.
6. Switch RANGE to "±12.00 ns". Adjust trimpot R503 so that the display reads 0.00.
7. Add the single conductor into the path between TXA and TXB. Adjust trimpot R502 so that the display indicates the known delay of the conductor.
8. Repeat steps 4 - 7 until no further adjustment is necessary.
9. Remove power and reassemble the case.

NOTE: The S501, MODE switch, should remain in the "Operate" position. Its "Calibrate" position is no longer used.)

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