ENCODER DATA SHEET

LSI MicroSeries µS/16 Family

Features:

- ☐ **Resolution to 0.33 Arc Minutes**
- ☐ **Accuracy to 0.5 Arc Minutes**
- ☐ **Small Size**
- ☐ **Absolute Non-Volatile Output**
- ☐ **LED Illuminators**
- ☐ **High Reliability**
- ☐ **Low Power, Single + 5V Input**
- ☐ **3-State Outputs**
- ☐ **Microprocessor Interface Capability**
- ☐ **Environmentally Sealed Case**
- ☐ **Versatile Input/Output interfaces**

General Description

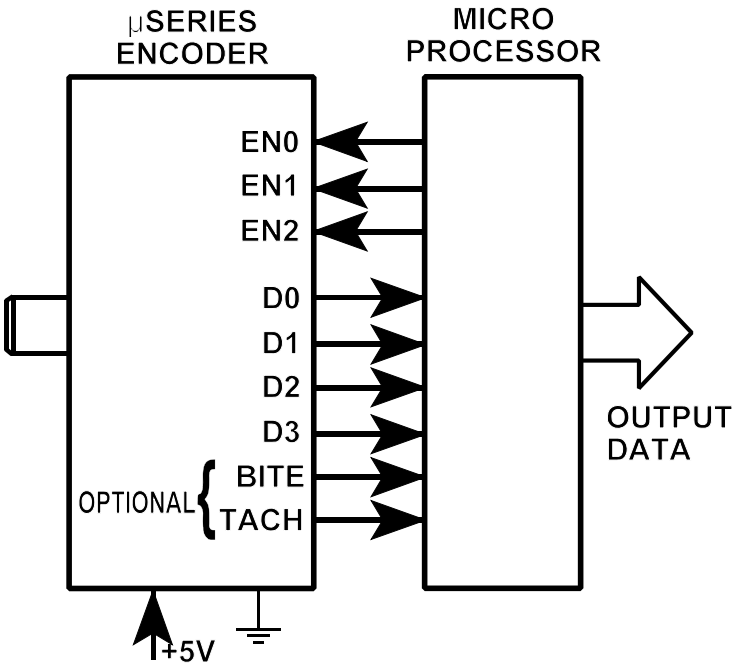
MicroSeries® Encoders are ultra small, absolute, optical shaft encoders. They have substantially better accuracy than other shaft angle digitizers. MicroSeries® Encoders are designed for applications where small size, medium resolution and insensitivity to power interruptions are desired. The LSI MicroSeries® was introduced to significantly reduce the size of the Encoder, lower the cost, and provide a more versatile electrical interface.

The basic model in the LSI MicroSeries® family is designated L. In this model, the outputs are 3-State and can interface directly with a microprocessor. The microprocessor demultiplexes the signals and converts them to natural binary code. The microprocessor can be provided by the user, or by BEI. For those applications where a microprocessor is not available or suitable, BEI offers a MicroSeries® Digital Decoder. The MicroSeries® Digital Decoder is a custom, monolithic gate array which can be separate (LS Models) or can be contained within the Encoder package (LC Models).

Detailed technical information is contained in Technical Bulletins "LSI MicroSeries® Encoders - Principles of Operation/Microprocessor Control and Decoding" and "MicroSeries® Digital Decoder." These bulletins are available upon request. For encoders with greater resolution, refer to Encoder Data Sheet "LSI MicroSeries® µS__/23 Family." For encoders with a through hole, refer to Encoder Data Sheets “Pancake LSI MicroSeries® µS__/40 Family, µS__/50 Family and µS__/80 Family." For reference to other BEI Models refer to the Short Form Catalog.

Specifications applicable to all members of the µS__/16 Family are listed on the back page. Individual models are described on the pages headed µS__/16L (pp. 2 & 3), µS__/16LS (pp. 4 & 5), and µS__/16LC (pp. 6&7).

Approved for general release.



Detailed Description

The L model is the basic encoder configuration which outputs a 4 wire multiplexed, 3-State Logic Level, MicroSeries® Code Word. The encoder is addressed by 3 Enable lines activated in a controlled sequence. This model is intended for direct interface with a user (or BEI) furnished microprocessor where the microprocessor can be programmed to perform the encoder's digital logic functions. For programming details, request BEI Technical Bulletin “LSI MicroSeries® Encoders - Principles of Operation/Microprocessor Control and Decoding.”

Detailed Specifications

Mechanical

Length: 2.16 inches max. (Dimension A on back page)
Standard Cable: 9 Conductors (12 conductors with optional Tach and/or BITE)

Electrical

☐ Typical Power Requirements (+ 5V DC, 2% Regulation, 1% max. pp Ripple)

	1 Station	2 Stations
Peak	425 mW	600 mW
Average*	250 mW	425 mW

* Average power calculated at 100 interrogations/second.
(For power requirements at other interrogation rates refer to Technical Bulletin.)

☐ Input Octal Address (EN0, EN1, EN2) 0/5V CMOS Compatible
1 µa Max., 20pf Max.

☐ Output (DØ, D1, D2, D3) 0/5V
Loading: 5 LSTTL Loads per Output

☐ Pin/Wire Designations:

PIN or WIRE #	FUNCTION	
1 (Red Edge)	GND	Power
2	+ 5V	
3	EN2	Input Octal Address
4	EN1	
5	ENØ	
6	DATA 3	Multiplexed Data Output
7	DATA 2	
8	DATA 1	
9	DATA Ø	
10	TACH	Optional
11	BITE	
12	GND	

Ordering Information

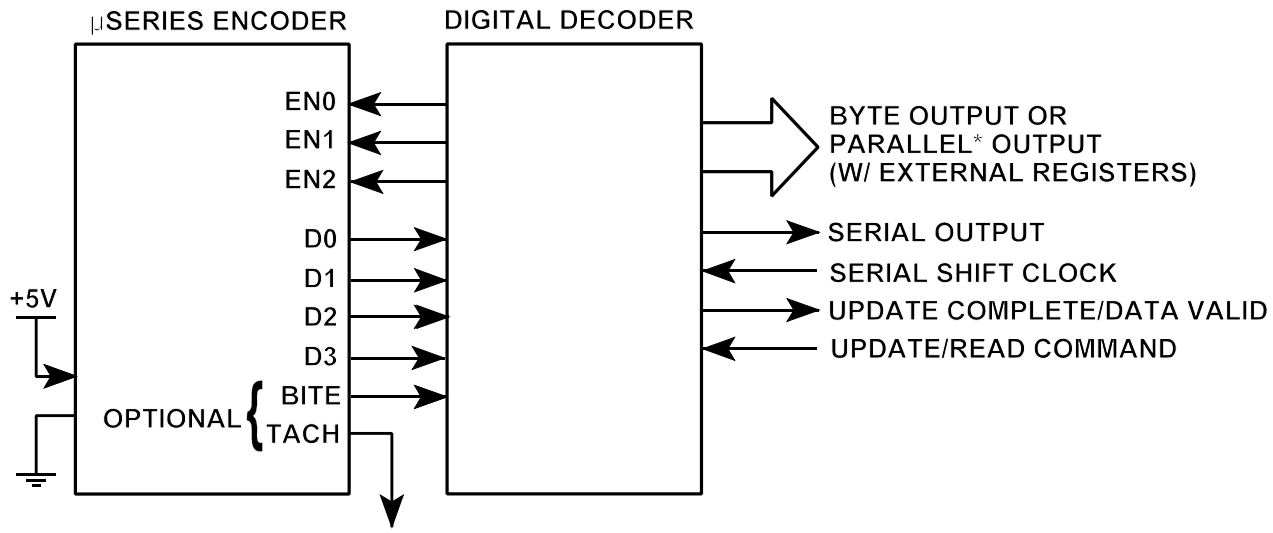
MicroSeries® µ S 1 5 / 1 6 (1) L

- **Resolution Bits/Turn**
- **1.6 inch Outside Diameter**
- **Reading Stations (1) or (2)**

Specify options as follows:

MS1	Hi Rel Integrated Circuits
MS2	Extended Temperature
MS3	Built-in Test (BITE)
MS4	Tach

Note: [1] Special modifications for Space/Vacuum operation can be provided.
[2] Consult factory for 17 or 18-bit resolution (only applicable to L Model).



Detailed Description

The LS model consists of the basic L encoder (described in the preceding pages) and a separate Digital Decoder. The use of the external Digital Decoder is suggested when the user does not have a microprocessor available to perform the digital processing of the outputs of the L Model encoder or when the length of the µS__/16LC encoder exceeds available space in the intended application. The external digital decoder affords the user the flexibility to access the various input/output programming modes available with MicroSeries® encoders.

The external Digital Decoder can be user programmed for three output modes: serial, 8-bit byte, or parallel*. Additionally, two data acquisition modes are possible: Update and Read. Request BEI Technical Bulletin "MicroSeries® Digital Decoder."

Detailed Specifications

Mechanical

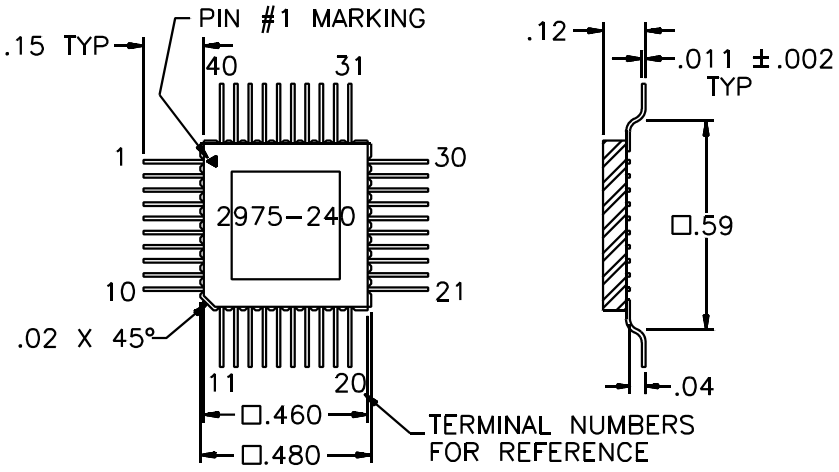
Encoder:

Length:

2.16 inches max. (Dimension A on back page)

Standard Cable:

9 Conductors (12 conductors with optional Tach and/or BITE)



Digital Decoder:

CMOS, Monolithic Gate Array

40 Pin; 4 Sided, Flatpack with leads on .040 centers

* 8-bit bytes with strobe signals to latch external registers

Electrical

☐ Typical Power Requirements (+ 5V DC, 2% Regulation, 1% max. pp Ripple)

	1 Station	2 Stations
Peak	450 mW	625 mW
Average*	275 mW	450 mW

* Average power calculated at 100 interrogations/second.
(For power requirements at other interrogation rates refer to Technical Bulletin.)

☐ Input Levels — 0/5V, TTL and CMOS Compatible, 1 CMOS unit load

☐ Output Levels — 0/5V, Short Circuit Protected
Loading: 8 LSTTL Loads per Output

☐ Pin/Wire Designations:

Encoder: Same as µS__/16L
Digital Decoder: Refer to BEI Technical Bulletin "MicroSeries® Digital Decoder."

☐ Output Code — Unambiguous Natural Binary

Ordering Information

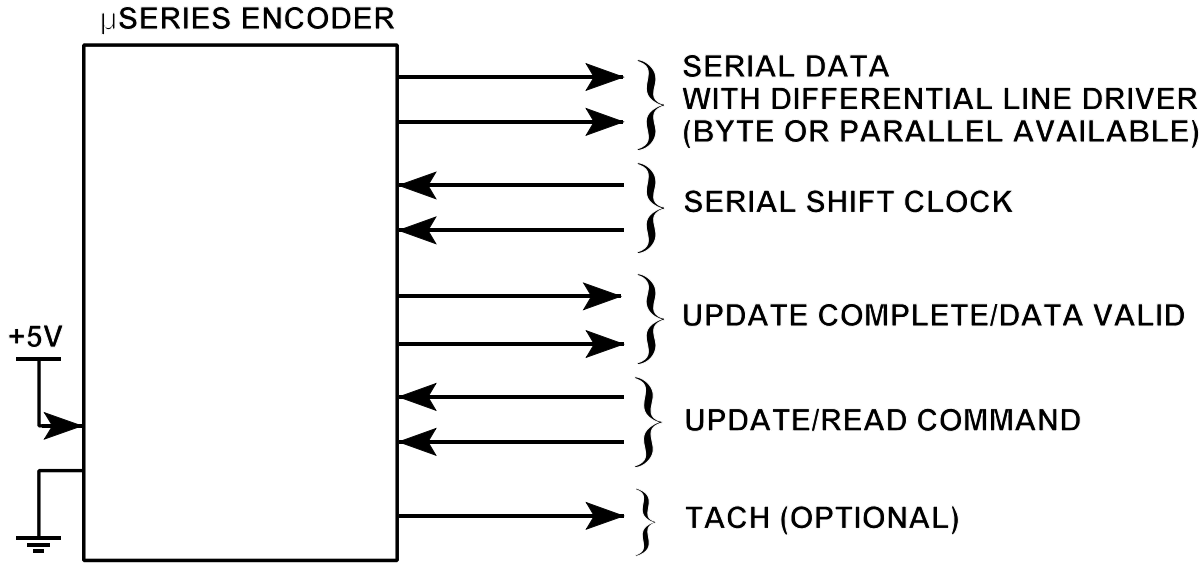
MicroSeries® µ S 1 5 / 1 6 (1) LS

- **Resolution Bits/Turn**
- **1.6 inch Outside Diameter**
- **Reading Stations (1) or (2)**

Specify options as follows:

MS1	Hi Rel Integrated Circuits
MS2	Extended Temperature
MS3	Built-in Test (BITE)
MS4	Tach

Note: [1] Special modifications for Space/Vacuum operation can be provided.



Detailed Description

The LC Model contains an integral MicroSeries® Digital Decoder Chip. This model, essentially similar to the µS/__16LS, is appropriate when an encoder without external processing circuits is desired. Output modes available are serial with differential line drivers, 8-bit bytes with TTL-compatible outputs, and parallel (8-bits at a time) with strobe signals to latch user-supplied external registers. Both Update and Read acquisition modes are available. User must specify the input and output modes of operation at time of order.

Detailed Specifications

Length(Dimension A on back page):	8-Bit Byte/Parallel Output	- 2.48 inches max.
	Serial Output	- 2.74 inches max.
Standard Number of Cable Conductors:		
	Serial Output	- 12 standard*
	Byte or parallel Output	- 17 standard

Electrical

ALL OUTPUT MODES

☐ Typical Power Requirements (+5V DC, 2% Regulation, 1% Ripple):

	PARALLEL/8-BIT BYTE		**SERIAL (Excludes Tach Option)**	
	1 Station	2 Stations	1 Station	2 Stations
Peak	450 mW	775 mW	1 WATT	1.2 WATTS
Average**	275 mW	450 mW	850 mW	1 WATT

☐ Data Acquisition Time — 120µ Sec. Min.
128µ Sec. Min. (Parallel Output)

☐ Output Code — Unambiguous Natural Binary

* **9 conductor cable available without Update Complete/Data Valid Line and without Tach option.**

** **Average power calculated at 100 interrogations/second. For other interrogation rates refer to Technical Bulletin.**

SERIAL OUTPUT MODE

☐ Input/output levels 9637/38 Receivers/Drivers

☐ Shift Clock 1MHz (User Supplied)

☐ Pin/Wire Designations:

PIN or WIRE NO.	FUNCTION	PIN or WIRE NO.	FUNCTION
1(Red Edge)	GND	7	Serial Clock'
2	Tach	8	Serial Output
3	Tach'	9	Serial Output'
4	Update/Read Command	10	Update Complete/Data Valid
5	Update/Read Command'	11	Update Complete/Data Valid'
6	Serial Clock	12	+5V

BYTE (OR PARALLEL) OUTPUT MODE

☐ Input Levels 0/5V, TTL and CMOS Compatible, 1 CMOS Unit Load

☐ Ouput Levels 0/5V, Short Circuit Protected
Loading: 8 LSTTL Loads per Output

☐ Pin/Wire Designations:

PIN or WIRE NO.	FUNCTION	PIN or WIRE NO.	FUNCTION
1(Red Edge)	DB7	10	+5V
2	DB6	11	Update Complete/Data Valid*
3	DB5	12	Guard/NC
4	DB4	13	ADRØ(Latch1)
5	DB3	14	Guard/NC
6	DB2	15	ADR 1(Latch 2)
7	DB1	16	GND
8	DBØ	17	Update/Read Command
9	Tach		

* Pin 11 is Latch 3 on 16-bit units with BITE and 17 bit units

Ordering Information

MicroSeries® µ S 1 5 / 1 6 (1) LC U B

Resolution Bits/Turn

1.6 inch Outside Diameter

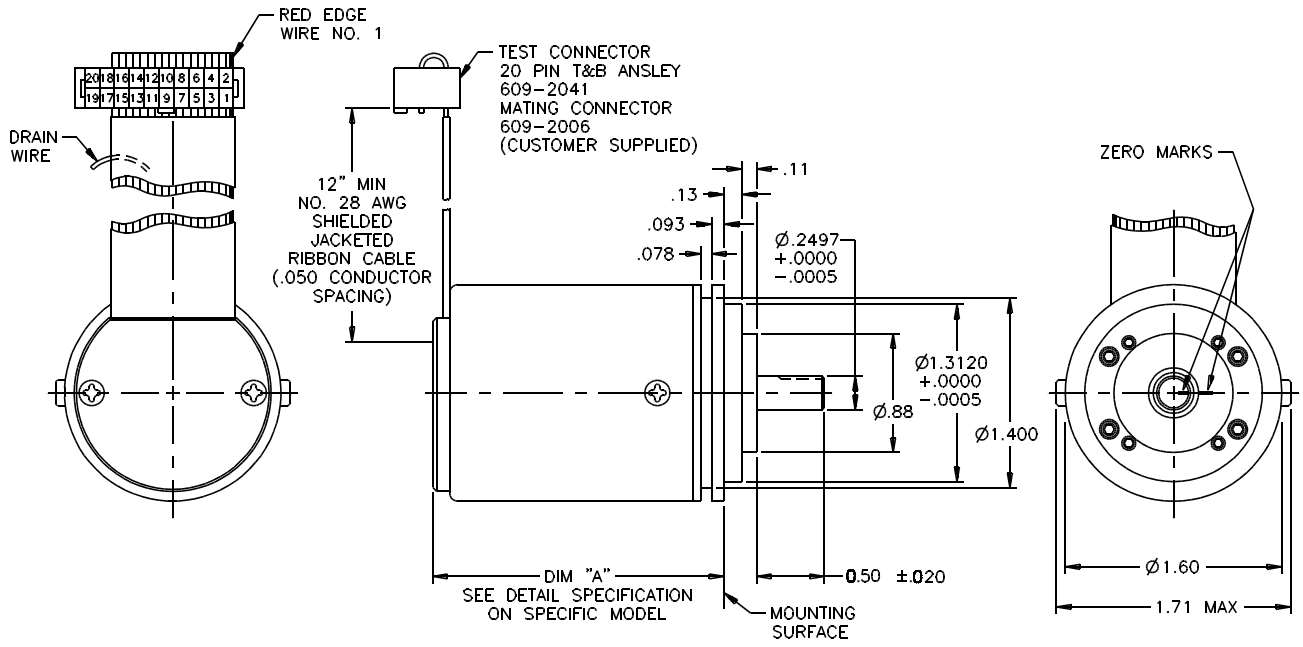
Reading Stations (1) or (2)

Data Output mode:
B = Byte
S = Serial
P = Parallel with (User Supplied) external latches

Data Acquisition Mode:
U = Update
R = Read

Specify Options As Follows:

MS1	Hi-Rel Integrated Circuits	MS2	Extended Temperature
MS3	Built-in Test (BITE)	MS4	Tach
MS5	CCW For Increasing Count Facing the Mtg. Surface		



General Specifications (L, LS and LC)

	Quanta/Revolution	Resolution (Arc Minutes)	Accuracy[1] (Arc Minutes) No. of Stations 1	2
µS13/16	8192	2.64	2.0	----
µS14/16	16384	1.32	1.4	----
µS15/16	32768	0.66	1.0	0.7
µS16/16	65536	0.33	----	0.5

Interrogation Rate/Acquisition Time	5kHz max./Data Acquisition Time 120 µsec min.
Operating Speed	450 rpm max.
Rotation (for increasing count)	Clockwise facing mounting surface
Slew Speed (nonoperating)	3600 rpm max.
Operating Temperature Range - Standard	-40 to +71°C
Optional	-54 to +85°C
Torque - Breakaway	1.5 oz-in max. at 25°C
Running	1.5 oz-in max. at 25°C
Moment of Inertia	0.023 oz-in^2 max. (0.06 x 10^{-3} oz-in-sec^2 max.)
Shaft Loading - Axial	2.0 lb max.
Radial	1.0 lb max. (at 0.125 inch from front face)
Weight	8 oz. max. (Stainless steel base)
Rated Life, Bearings	10^9 revolutions min.
Rated Life, LED	100,000 hours min.
MTBF	300,000 hours typical (calculated per MIL-HDBK-217 Ground Fixed)
Digital Tach Output Option	16384 Cycles/Revolution Square Wave

(1) Peak transition error of transducer and electronics. Excludes quantizing error of ½ LSB.

Specifications subject to change without notice.