

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[®] μ S_/23 Family." For encoders with a through hole, refer to Encoder Data Sheets "Pancake LSI MicroSeries[®] μ S_/40 Family, μ S_/50 Family and μ S_/80 Family." For reference to other BEI Models refer to the Short Form Catalog.

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

Approved for general release.

LSI MicroSeries [°] µS__/16L



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)
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LSI MicroSeries [°] µS__/16L

Electrical

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

		Peak Average*	1 Stati 425 m' 250 m'	on W W	2 Stations 600 mW 425 mW			
 * Average power calculated at 100 interrogat (For power requirements at other interrogat) 					ogations/seco ogation rates	ond. s refer to T	echi	nical 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 STTL Loads per Output					
Pin	/Wi	re Designatior	ns:	PIN or WIRE #	FUNCTION		ouus	
				1 (Red Edge) 2	GND + 5V	} Power		
				3 4 5	EN2 EN1 ENØ	} Input (Octa	Il Address
				6 7 8 9	DATA 3 DATA 2 DATA 1 DATA Ø	} Multip	olexe	ed Data Output
				10 11 12	TACH BITE GND	} Option	nal	
Ordering Information								
No	O F te:	Resoluti Bits/Tu 1.6 in utside Diamet Reading Statio (1) or ¹ Special ma ² Consult fa	on irn ch ter ons (2) odificati	ons for Space/v r 17 or 18-bit r	Vacuum oper esolution (or	MS1 MS2 MS2 MS4 ration can l	be projector	Hi Rel Integrated Circuits Extended Temperature Built-in Test (BITE) Tach rovided. o L Model).
	* Ou Pin	* Ave (Fo Input C Output Pin/Wi Pin/Wi	Peak Average* * Average power ca (For power required) Input Octal Address (Output (DØ, D1, D2, Pin/Wire Designation MicroSeries Resoluti Bits/Tu 1.6 in Outside Diamed Reading Station (1) or Note: ¹ Special ma ² Consult fa	Peak 425 m Average* 250 m * Average power calculated (For power requirements) Input Octal Address (ENO, ENO, Output (DØ, D1, D2, D3) Pin/Wire Designations: * dering Information MicroSeries* µ S * Resolution Bits/Turn 1.6 inch Outside Diameter Reading Stations (1) or (2) Note: 1 Special modificati 2 Onsult factory for	Peak 425 mW Average* 250 mW * Average power calculated at 100 interner (For power requirements at other interner) Input Octal Address (ENO, EN1, EN2) Output (DØ, D1, D2, D3) Pin/Wire Designations: PIN or WIRE # 1 (Red Edge) 2 3 4 5 6 7 8 9 10 11 12 rdering Information MicroSeries* µS 1 5 / 1 6 (1) Resolution	Peak Average* 1 Station 250 mW 2 Stations 600 mW 425 mW * Average power calculated at 100 interrogations/secon (For power requirements at other interrogation rate) 0/5V CMOS 1 µa Ma Input Octal Address (EN0, EN1, EN2) 0/5V CMOS 1 µa Ma Output (DØ, D1, D2, D3) 0/5V Loading: Pin/Wire Designations: PIN or WIRE # FUNCTION 1 (Red Edge) 2 GND + 5V 3 EN2 4 4 EN1 5 6 DATA 3 7 7 DATA 2 8 8 DATA 1 9 9 DATA Ø 10 TACH 11 11 BITE 12 12 GND 10 TACH BITS/Turn 1.6 inch	Peak Average* 1 Station 425 mW 500 mW 425 mW 2 Stations 600 mW 425 mW * Average power calculated at 100 interrogations/second. (For power requirements at other interrogation rates refer to T Input Octal Address (ENO, EN1, EN2) 0/5V CMOS Compatible 1 µa Max., 20pf M Output (DØ, D1, D2, D3) 0/5V Loading: 5 LSTTL L Pin/Wire Designations: 0/5V Loading: 5 LSTTL L Pin/Wire Designations: 1 (Red Edge) 3 4 5 6 0ATA 3 7 0ATA 2 8 0ATA 4 9 0ATA Ø GND Power 3 6 0ATA 3 7 0ATA 2 8 0ATA 1 9 0ATA Ø 10 11 12 6 0DATA Ø TACH 11 8 15 / 1 6 (1) L Multip 9 0ATA Ø 10 12 6 0DATA Ø TACH 11 8 16 inch MSS 0utside Diameter Reading Stations MSS MSS MSS Note: 1 2 0000 Special modifications for Space/Vacuum operation can 2 0 Consult factory for 17 or 18-bit resolution (only application)	Peak Average* 1 Station 425 mW 2 Stations 600 mW * Average power calculated at 100 interrogations/second. (For power requirements at other interrogation rates refer to Techn Input Octal Address (ENO, EN1, EN2) 0/5V CMOS Compatible 1 µa Max., 20pf Max. Output (DØ, D1, D2, D3) 0/5V Loading: 5 LSTTL Loads Pin/Wire Designations: 0/5V Pin/Wire Designations: 1 (Red Edge) 2 GND + 5V 1 (Red Edge) 2 GND + 5V Power 3 EN2 4 Input Octal 5 6 DATA 3 7 Multiplexe 9 DATA 4 Multiplexe 10 TACH 11 BITE 2 Optional 10 TACH 12 MS1 MS1 MS1 MS2 Outside Diameter Reading Stations (1) or (2) MS1 MS4 MS1 MS4

LSI MicroSeries [°] µS__/16LS



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 μ S__/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

Pag	ge 5		Encoder Data Sheet			
			LSI MicroSeries [®] µS/16LS			
Ele	ectrical					
	Typical Power Requir	ements (+ 5V DC, 2%	S Regulation, 1% max. pp Ripple)			
		1 Station	2 Stations			
	Peak	450 mW	625 mW			
	Average*	275 mW	450 mW			
	* Average power ca	alculated at 100 inter	rrogations/second.			
	(For power requi	rements at other inte	errogation 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 Designation	ns:				
		Encoder:	Same as µS/16L			
	Di	gital Decoder:	Refer to BEI Technical Bulletin			
			"MicroSeries [®] Digital Decoder."			
	Output Code		Unambiguous Natural Binary			

Ordering Information



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.

Encoder Data Sheet

LSI MicroSeries [°] µS__/16LC



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/Par	- 2.48 inches max.		
		2	Serial Output		- 2.74 inches max.	
Standard Number	of Cable Cond	ductor	'S:			
		9	Serial Output		 12 standard* 	
				el Output	- 17 standard	
Electrical						
ALL OUTPUT MO	DES					
□ Typical Power	Requirement	s (+5V	DC, 2% Regul	ation, 1% Ripp	le):	
	PARALLEL/8-	BIT B	/TE	SERIAL (Exclue	des Tach Option)	
	1 Station	2 Stati	ons	1 Station	2 Stations	
Peak 450 mW 775		775 m	W	1 WATT	1.2 WATTS	
Average** 275 mW 450		450 m	W	850 mW	1 WATT	
Data Acquisition Time			120µ Sec. Min.			
		-	128µ Sec. Min	i. (Parallel Outp	out)	
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.

LSI MicroSeries [°] µS__/16LC

SERIAL OUTPUT MOD	DE		
□ Input/output leve	ls	9637/38 Red	ceivers/Drivers
Shift Clock		1MHz (User Sı	upplied)
Pin/Wire Designation	tions:		
PIN or		PIN or	
WIRE NO.	FUNCTION	WIRE NO.	FUNCTION
1(Red Edge)	GND	7	Serial Clock'
2	Tach	8	Serial Output
3	Tach'	9	Serial Output'
4	Update/Read Comman	d 10	Update Complete/Data Valid
5	Update/Read Comman	d' 11	Update Complete/Data Valid'
6	Serial Clock	12	+5V
BYTE (OR PARALLEL)	OUTPUT MODE		
Input Levels	(D/5V, TTL and CM	OS Compatible, 1 CMOS Unit Load
Ouput Levels	(0/5V, Short Circui	t Protected
	L	_oading: 8 LSTTL L	.oads per Output
Pin/Wire Designation	tions:	-	
PIN or		PIN or	
WIRE NO EU	NCTION	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 or	16-bit units with BITE a	nd 17 bit units	
Ordering Infor	mation		
MicroSerie	es® µ S 1 5 / 1	6 (1) LC U B	
Decoluti			Data Outraut made
Resoluti	ion		Data Output mode:
DILS/ IL	urn		B = Byle
1.6 ir	sch		5 = Serial B = Barallal with (Usor Supplied)
1.0 II Outsida Diama	tor		evternal latches
Outside Dialite			Data Acquisition Mode
Reading Static	ns		Data Acquisition Mode:
(1) or	(2)		R = Read
(1) 01	(-)		it itead
Specify Options As Fo	allows:		
	ntegrated Circuits	N/C2	Extended Temperature
	Toct (DITE)		
IVISS BUILTIN	TEST (DITE)	IVI34	
IVISS CCW FC	or increasing Count F	acing the Mitg. Su	inace

LSI MicroSeries µS/16 Family



			Accuracy ⁽¹⁾ (Arc Minutes) No. of Stations			
	Quanta/Revolution	Resolution (Arc Minutes)	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/Ac	cquisition Time	5kHz max./Data Acquisition Time 120 µsec min.				
Operating Speed		450 rpm max.				
Rotation (for increasi	ng count)	Clockwise facing mounting surface				
Slew Speed (nonoper	ating)	3600 rpm max.				
Operating Temperatu	ire 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 - A	xial	2.0 lb max.				
R	adial	1.0 lb max. (at 0.125 inch from fr	ont 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 O	ption	16384 Cycles/Revolution Square Wave				

Specifications subject to change without notice.