ENC-AMT21 Capacitive Modular Encoder

FEATURES

- 12 or 14-Bit Absolute Position or Multi-Turn Capability
- Compact Modular Package with Locking Hub
- Patented Capacitive ASIC Technology
- Settable Zero Position
- 3.3 V Half-Duplex RS485
- Kit with 9 Sleeve Options (.079” to .315”)
- High Speed Protocol for Fast Low Latency Position Data
- Radial and Axial Cable Connections
- -40 to 105° Operating Temperature

DESCRIPTION

The AMT21 Modular Absolute Encoder is based on a new type of Capacitive technology. With CUI’s new patented Capacitive ASIC technology this Encoder is superior in every way compared to other Encoders (Magnetic, Optical). The AMT21 is a rugged, high accuracy Absolute Encoder outputting 12 Bits or 14 Bits of Absolute position information with RS-485 communication and single-turn or multi-turn output options, all in just one AMT21 Encoder. Also, there are 9 shaft diameter options, included in each kit. Each AMT21 comes with 9 color coded bore sleeves, ranging from .079” to .315” that will adapt to 9 different motor shaft diameters. Also, included are two mounting tools, and with one standard and one wide baseplate that has multiple pre-drilled mounting hole patterns designed to mate with a wide range of motors. Furthermore, because of the Capacitive platform it is not susceptible to contaminants such as dirt, dust, and oil that usually plague encoders in industrial environments. With its compact package and low current draw, it’s unlike any other Encoders. The AMT21 is the perfect solution for your business, whether it’s for industrial, automation, robotics, or renewable energy applications.

ORDERING INFORMATION

ENC - AMT212E - V

Capacitive Modular Encoder

RS485 Protocol

Orientation	
2	Radial
3	Axial

Absolute Resolution	
E	12-Bit Single-Turn
F	14-Bit Single-Turn
G	12-Bit Multi-Turn
H	14-Bit Multi-Turn

V-Kit Includes:	
Total of 9 Bore Sleeves	
Diameter	Color
.079”	Light Sky Blue
.118”	Orange
.125”	Purple
.157”	Gray
.188”	Yellow
.197”	Green
.237”	Red
.250”	Snow
.315”	Blue
Total of 2 Tools	
Tool A	Spacer Tool
Tool C	Shaft Tool
Total of 1 Cover, 2 Bases, 1 Shaft Adapter	
Top Cover	
Standard Base	
Wide Base	
Shaft Adapter	

L011844

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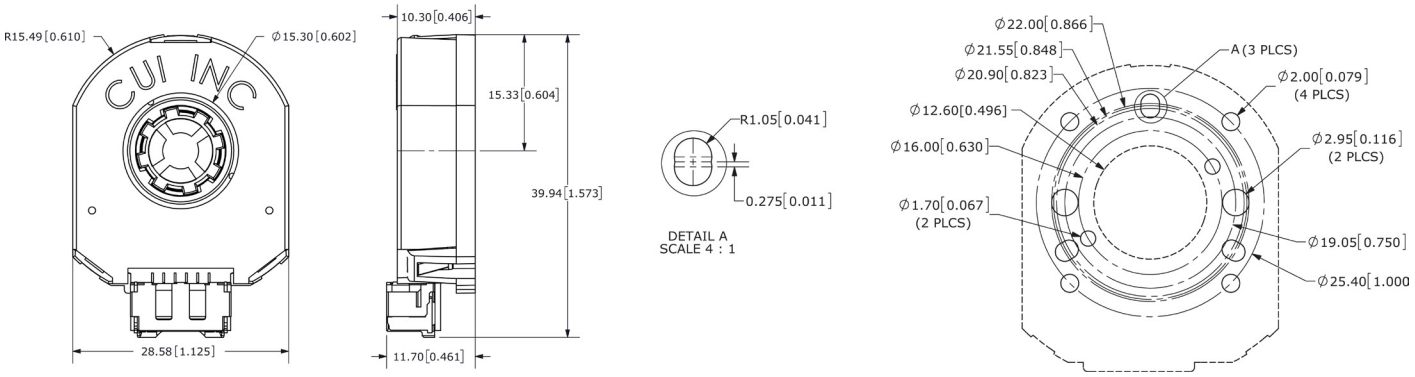
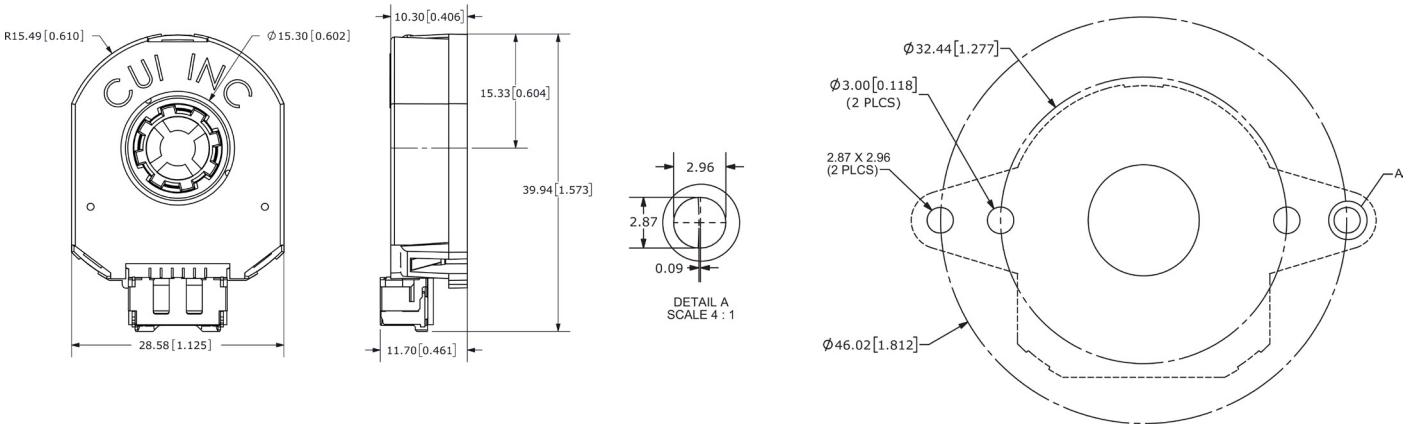
ENC-AMT212 (Radial Connection)



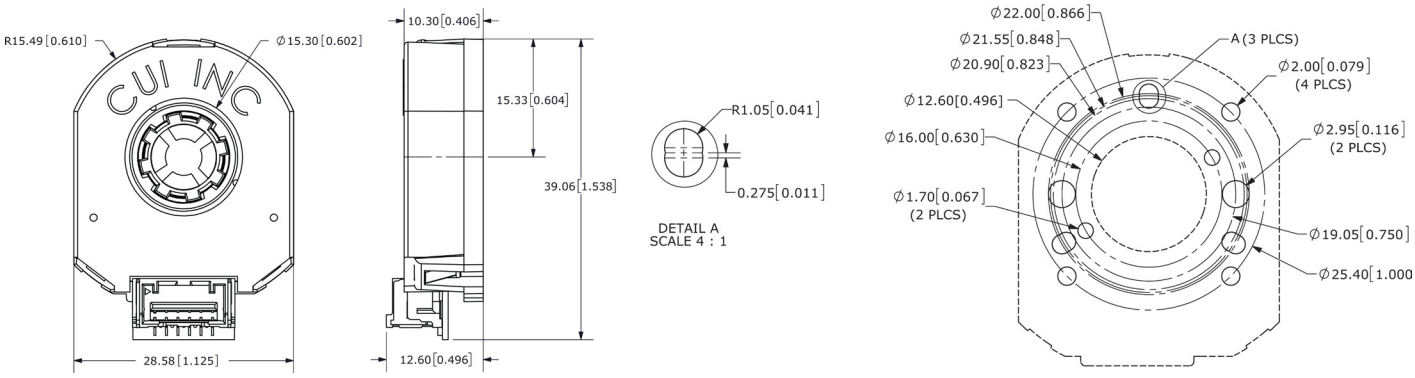
Units are in mm

ENC-AMT212 Wide Base (Radial Connection)



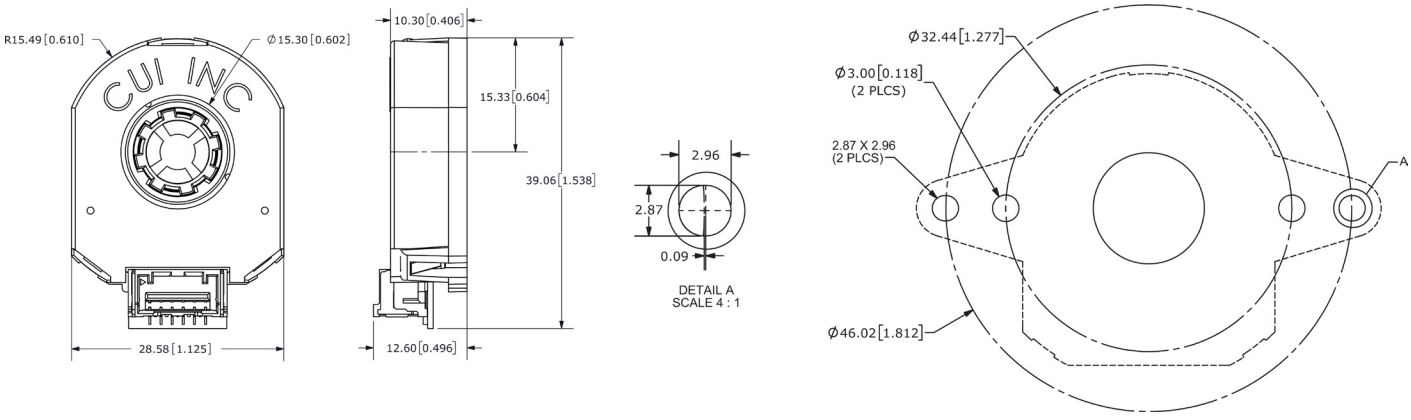
Units are in mm

ENC-AMT213 (Axial Connection)



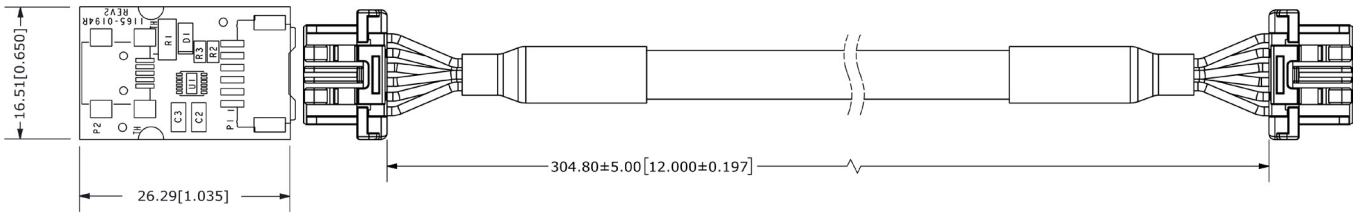
Units are in mm

ENC-AMT213 Wide Base (Axial Connection)



Units are in mm

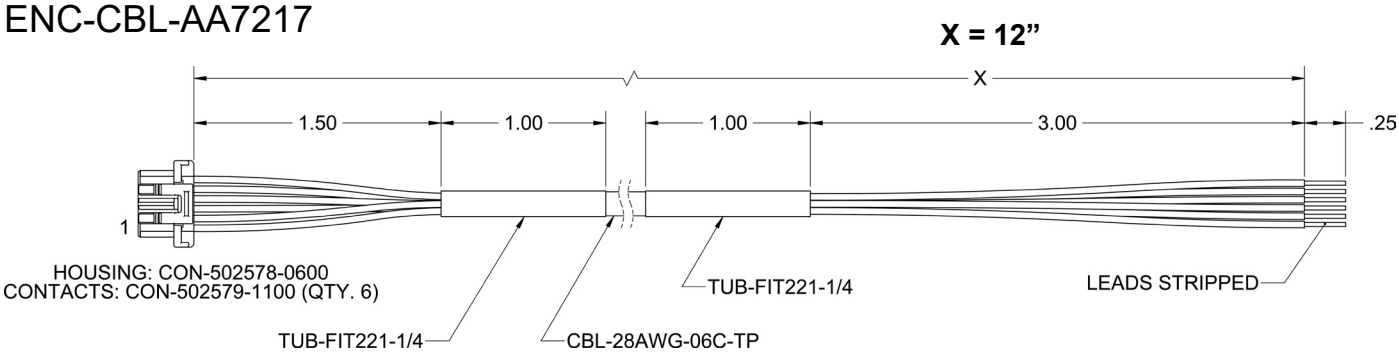
ENC-AMT-PRGM-06C



Tolerance: ±0.127 mm

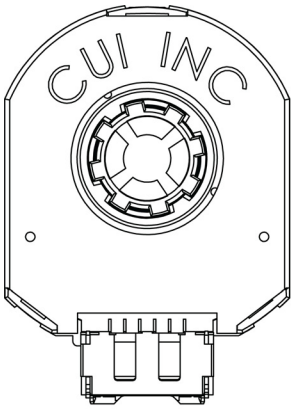
Units are in mm

ENC-CBL-AA7217

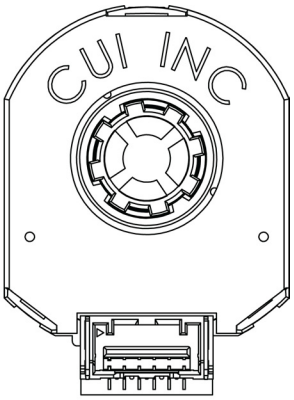


Units are in inches

ENC-AMT212



ENC-AMT213



Mating Connector[2]:
Molex 502578-0600

Notes: 1. Pins 5 and 6 are used for configuration only and should be left disconnected for RS485.
2. Compatible with prototype cable ENC-CBL-AA7217 and programming cable ENC-AMT-PGRM-06C

PINOUT CONNECTOR

Function	
Pin #	ENC-AMT212 & ENC-AMT213
1	+5 V
2	B
3	A
4	GND
5[1]	MODE
6[1]	MCLR

Electrical

Parameter	Conditions / Description	Min	Typ	Max	Units
Power Supply	VDD	3.8	5	5.5	V
Start-Up Time	-	-	200	-	ms
Current Consumption	with Unloaded Output	-	8	-	mA

Absolute Position Characteristics

Parameter	Conditions / Description	Min	Typ	Max	Units
Resolution	12 or 14-Bit	-	-	-	-
Accuracy	-	-	0.2	-	degrees
Absolute Zero Position	Settable via AMT Viewpoint GUI or RS485	-	-	-	-
Multi-Turn	Multi-Turn and Single-Turn Versions Available	-	-	-	-
Turns Counter[1]	Signed Binary Number	-	14	-	Bits
Absolute Position Update Rate	12-Bit 14-Bit	-	25 100	-	µs µs

Notes: 1. Multi-Turn encoders only.

Mechanical

Parameter	Conditions / Description	Min	Typ	Max	Units
Motor Shaft Length	-	9	-	-	mm
Weight	-	-	.034	-	lbs
Axial Play	-	-	-	±0.3	mm
Rotational Speed (at each resolution)	12-Bit Position Resolution 14-Bit Position Resolution	-	-	8,000 4,000	RPM RPM

Environmental

Parameter	Conditions / Description	Min	Typ	Max	Units
Operating Temperature	-	-40	-	105	°C
Humidity	Non-condensing	-	-	85	%
Vibration	10~500 Hz, 5 minute sweep, 2 hours on each XYZ	-	-	5	G
Shock	3 Pulses, 6 ms, 3 on each XYZ	-	-	200	G
RoHS	2011 / 65 / EU	-	-	-	-
REACH	EC 1907 / 2006	-	-	-	-

RS485 Interface - 2 MBPS Data Rate [A,B,C,D Options]

Parameter	Conditions / Description	Min	Typ	Max	Units
Protocol	RS485 Balanced Digital Multi-Port Interface	-	-	-	-
Data Rate	8 Data Bits, No Parity, 1 Stop Bit, Asynchronous	-	2	-	Mbps
Transceiver	Texas Instruments SN65HVD75	-	-	-	-
Latency	Time before encoder responds with position	18	-	29	µs
Driver Differential Output Voltage Magnitude	Load Resistance = 54 Ω	1.5	2	3.3	V

RS485 Interface - Adjustable Data Rate [E,F,G,H Options]

Parameter	Conditions / Description	Min	Typ	Max	Units
Protocol	RS485 Balanced Digital Multi-Port Interface	-	-	-	-
Data Rate[2] [3]	8 Data Bits, No Parity, 1 Stop Bit, Asynchronous 115,200; 38,400; 19,200; 9,600	-	-	-	bps
Transceiver	Texas Instruments SN65HVD72	-	-	-	-
Turnaround Time	Time before encoder responds with position				
	115,200 bps	10.8	-	-	µs
	38,400 bps	30	-	-	µs
	19,200 bps	56	-	-	µs
	9,600 bps	110	-	-	µs
Driver Differential Output Voltage Magnitude	Load Resistance = 54 Ω	1.5	2	3.3	V

Notes: 2. Data rate configured with AMT Viewpoint
3. Default data rate on kits is 115,200 bps.

Checksum

The AMT21 encoder uses a checksum calculation for detecting transmission errors. The upper two bits of every response from the encoder are check bits. Those values are shown in the examples below as K1 and K0. The check bits are odd parity; K1 for the odd bits in the response, and K0 for the even bits in the response. These check bits are not part of the position, but are used to verify its validity. The remaining lower 14 bits are the useful data. Here is an example of how to calculate the checkbits for a 16-bit response, from a 14-bit encoder.

Full response: 0x61AB
14-bit position: 0x21AB (8619 decimal)

Checkbit Formula

Odd: K1 = !(H5^H3^H1^L7^L5^L3^L1)
Even: K0 = !(H4^H2^H0^L6^L4^L2^L0)

From the above response 0x61AB:
Odd: 0 = !(1^0^0^1^1^1^1) = correct
Even: 1 = !(0^0^1^0^0^0^1) = correct

Addressing

The AMT21 encoder supports multiple encoders on the RS485 bus. This is accomplished by giving each encoder a unique node address. This node address is 8 bits long but the low two bits must be 0. Therefore, the encoder can have any single byte value that is divisible by 4 which allows up to 64 encoders to share the bus.

By default, the node address is 0x54. Node addresses configurable via AMT ViewpointTM or set at factory for specific configuration upon request.

Available RS485 Node Addresses (HEX)							
00	20	40	60	80	A0	C0	E0
04	24	44	64	84	A4	C4	E4
08	28	48	68	88	A8	C8	E8
0C	2C	4C	6C	8C	AC	CC	EC
10	30	50	70	90	B0	D0	F0
14	34	**54***	74	94	B4	D4	F4
18	38	58	78	98	B8	D8	F8
1C	3C	5C	7C	9C	BC	DC	FC

*Default address

The node address serves also as the read position command which is why it will be referred to it as the base command. When the encoder sees a command on the RS485 it reads the first 6 bits to determine if it should be listening. If it sees its address, then it interprets the low two bits for the command.

Low Two Bits	Hex	Command
00	0x00	Read Position
01	0x01	Read Turns Counter (Multi-Turn Encoders Only)
10	0x02	Indicates Extended Command
11	0x03	Reserved

For simplicity the user can abstract away the various bits and simply implement multiple commands in their system. For example:

Byte	Command
0x54	Read Position
0x55	Read Turns Counter (Multi-Turn Encoders Only)
0x56	Begin Extended Command

Extended Commands

There are some commands that require two bytes to be received before the encoder will enact them. This includes resets and zero saves. This prevents collisions and allows the encoder to be fully functional while sharing the bus with other encoders.

Note that there are no responses to these instructions, and once received the encoder initiates an immediate reset. The user's system should expect to wait until the encoder is powered back up to send any follow up commands. Power on time is listed in the electrical section above.

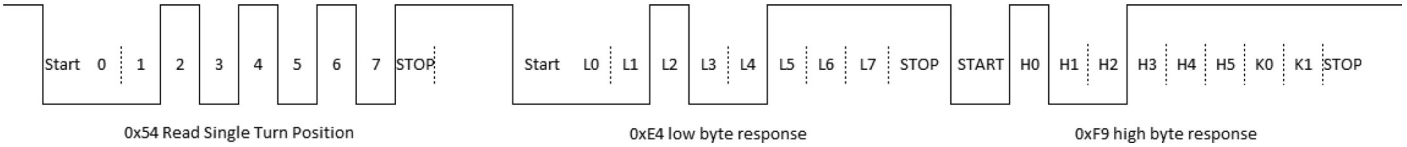
To send an extended command the user will send the <node address + 0x02> value (0x56 by default) followed by the <extended command>.

Extended Commands	Function
0x5E	Set Zero Position (Single Turn Encoders Only)
0x75	Reset Encoder

Single Character Commands

Read Position: <node_address>

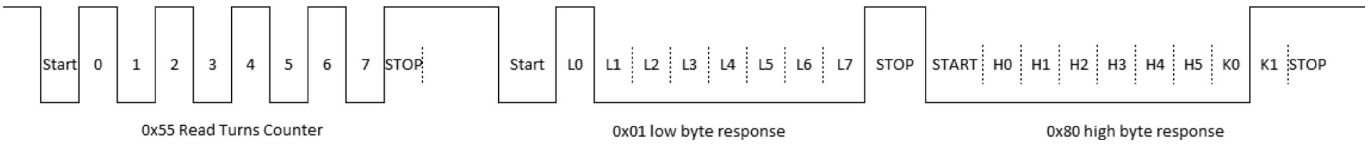
Read Position 0x54



The read position command is the same as the node address which has a default value of 0x54 is sent and the response is received with the low byte first. After removing the checksum the result is 0x39E4. For a 14-bit encoder nothing else is required, the position is 14820 in decimal. However if this is a 12-bit encoder, the position must be shifted to the right 2 bits to throw away the low bits of the response. Therefore the position would be 3705 in decimal.

Read Turns (Multi-Turn Encoders only): <node_address + 0x01>

Read Turns 0x55

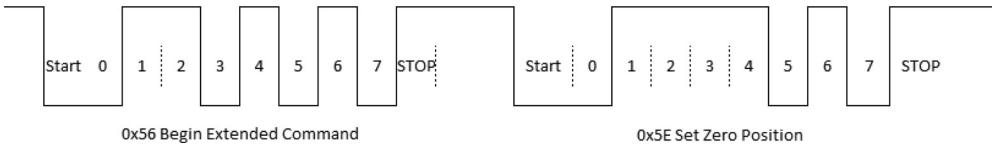


The turns counter command is <node_address + 0x01>. By default the turns counter command is 0x55. The encoder responds with the low byte first and includes check bits same as the read position command. The resulting number is a signed 14 bit number. The response above is showing 1 turn.

Extended Commands

Set Zero Position 0x56 0x5E - Single Turn Encoders Only: <node_address + 0x02> <0x5E>

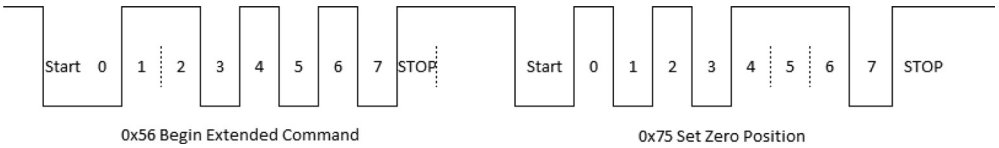
Set Zero Position 0x56 0x5E - Single Turn Encoders Only



The zero set command is <node_address + 0x02> followed by <0x5E>. By default we send 0x56 and then 0x5E. The encoder zero's the position and immediately resets.

Encoder Reset: <node_address + 0x02> <0x75>

Reset Encoder 0x56 0x75



The reset command is <node_address + 0x02> followed by <0x75>. By default the command to reset the encoder is 0x56 0x75. The encoder performs and immediate reset.

Covers:

ENC-AMT212	Top Cover
ENC-AMT213	Top Cover

TOP COVER

Bases:

ENC-AMT212 & ENC-AMT213	Base
ENC-AMT212 & ENC-AMT213	Wide Base

BASE

WIDE BASE

Tools:

(Tool A) Spacer Tool
(Tool C) Shaft Tool

Note: Also, included is a Shaft Adapter.

TOOL A

TOOL C

SHAFT ADAPTER

Sleeves:

The following bore sleeves are provided with the kit:

SLEEVES								
.079”	.118”	.125”	.157”	.188”	.197”	.237”	.250”	.315”
Light Sky Blue	Orange	Purple	Gray	Yellow	Green	Red	Snow	Blue

Everything shown below here is not included with the kit. These Connectors and Cables are sold separately:

Connectors:

Encoder Part #	Connector Part Number	Description
ENC-AMT212 & ENC-AMT213	MOLEX 502578-0600	Mating Connector

Cables:

Encoder Part #	Cable Part Number	Length
ENC-AMT212 & ENC-AMT213	ENC-AMT-PGRM-06C	12”
ENC-AMT212 & ENC-AMT213	ENC-CBL-AA7217	12”