HEWLETT PACKARD

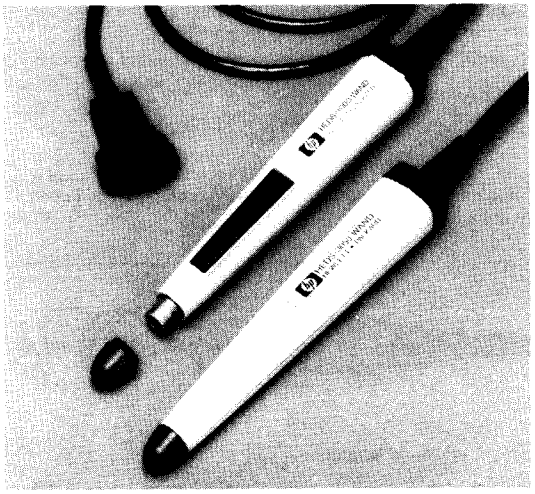
DIGITAL BAR CODE WAND

HEDS-3000
HEDS-3050

TECHNICAL DATA JANUARY 1986

Features

- **0.3 mm RESOLUTION**
  Enhances the Readability of dot matrix printed bar codes
- **DIGITAL OUTPUT**
  Open Collector Output Compatible with TTL and CMOS
- **PUSH-TO-READ SWITCH (HEDS-3000)**
  Minimizes Power in Battery Operated Systems
- **SINGLE 5V SUPPLY OPERATION**
- **ATTRACTIVE, HUMAN ENGINEERED CASE**
- **DURABLE LOW FRICTION TIP**
- **SOLID STATE RELIABILITY**
  Uses LED and IC Technology
- **SHIELDED CASE AND CABLE (HEDS-3050)**
  Maximizes EMI/ESD Immunity in AC Powered Systems



Description

The HEDS-3000 and HEDS-3050 Digital Bar Code Wands are hand held scanners designed to read all common bar code formats that have the narrowest bars printed with a nominal width of 0.3 mm (0.012 in.). The wands contain an optical sensor with a 700 nm visible light source, photo IC detector, and precision aspheric optics. Internal signal conditioning circuitry converts the optical information into a logic level pulse width representation of the bars and spaces.

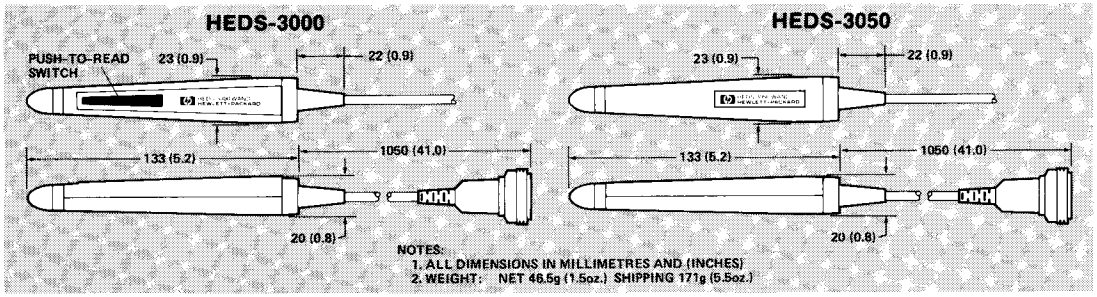
The HEDS-3000 comes equipped with a push-to-read switch which is used to activate the electronics in battery powered applications requiring lowest power consumption. The HEDS-3050 does not have a switch, and features internal metal shielding that maximizes immunity to electromagnetic interference, electrostatic discharge, and ground loops in AC powered systems. Both wands feature a strain relieved 104 cm (41 in.) cord with a nine-pin subminiature D-style connector.

Applications

The Digital Bar Code Wand is an effective alternative to the keyboard when used to collect information in self-contained blocks. Bar code scanning is faster than key entry and also more accurate since most codes have check-sums built-in to prevent incorrect reads from being entered.

Applications include remote data collection, ticket identification systems, security checkpoint verification, file folder tracking, inventory control, identifying assemblies in service, repair, and manufacturing environments, and programming appliances, intelligent instruments and personal computers.

Wand Dimensions



Electrical Operation

The HEDS-3000 and HEDS-3050 consist of a precision optical sensor, an analog amplifier, a digitizing circuit, and an output transistor. These elements provide a TTL compatible output from a single voltage supply range of 3.6V to 5.75V. A non-reflecting black bar results in a logic high (1) level, while a reflecting white space will cause a logic low (0) at the V_O connection (pin 2). The output of the wands is an open collector transistor.

The HEDS-3050 provides a case and cable shield (pin 5) which must be connected to logic ground and preferably also to earth ground. This will provide a substantial improvement in EMI/ESD immunity for the wand in AC powered systems.

The recommended logic interface for the wands is shown in Figure 3. This interconnection provides maximum ESD protection for both the wand and the user's electronics.

The HEDS-3000 incorporates a push-to-read switch which is used to energize the 700nm LED emitter and electronic circuitry. When the switch is initially depressed, its contact bounce may cause a series of random pulses to appear at the output, V_O. This pulse train will typically settle to a final value within 0.5 ms. This initial pulse train is eliminated when a switchless HEDS-3050 is used.

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units
Bar Width	s, b	0.3		mm
Scan Velocity	v_{scan}	7.6	76	cm/s
Contrast	PCS	70		%
Supply Voltage	V_S	3.6	5.75	V
Temperature	T_A	0	55	°C
Orientation	See Figure 1			

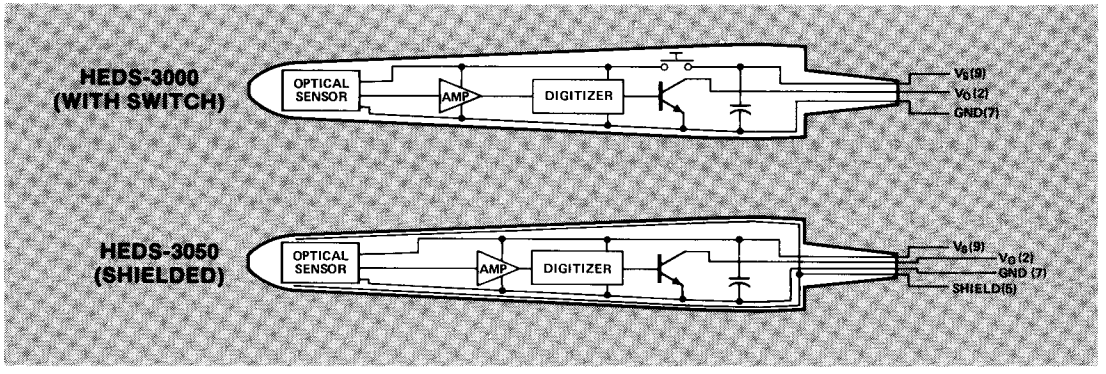
Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units	Notes
Storage Temperature	T_S	-20	55	°C	1
Operating Temperature	T_A	0	55	°C	
Supply Voltage	V_S	-0.5	6.0	V	2
Output Transistor Power	P_T		200	mW	
Output Collector Voltage	V_O		20	V	

Electrical Characteristics (V_S = 3.6V to 5.75V at T_A = 25°C, R_L = 2.2kΩ,unless otherwise noted)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions	Fig.	Notes
Switch Bounce(HEDS-3000)	t_{sb}		0.5	5	ms			3
High Level Output Current	I_{OH}			400	μA	V_{OH} = 2.4V, Bar Condition (Black)	3	
Low Level Output Voltage	V_{OL}			0.4	V	I_{OL} = 16mA, Space Condition (White)	3	
Output Rise Time	t_r		2		μs	10%-90% Transition	3	
Output Fall Time	t_f		100		ns	90%-10% Transition	3	
Supply Current	I_S		42	50	mA	V_S = 5V, Bar Condition (Black)		2,4

Block Diagram



GUARANTEED WIDTH ERROR PERFORMANCE

(V_S = 5V, T_A = 0°C to 55°C, R_L = 2.2kΩ, unless otherwise noted)

Parameter		Symbol	Min.	Typ.	Max.	Units	Conditions		Fig.	Notes
Bar Width Error	1st	Δb_1		0.08 (3.2)	0.13 (5.2)	mm (in.x10^{-3})	T_A=25°C	Margin ≥ 5mm Height = 0.25mm Tilt = 0° V_{scan} = 50 cm/s Standard Test Tag Preferred Orientation b=s=0.3mm (0.012 in.) 2b=2s=0.6mm (0.024 in.)	1 2,6 11	5 7,8 9,10 11
				0.10 (3.8)	0.15 (5.7)		T_A = 0° to 55°C			
	Interior	Δb	-0.04 (-1.4)	0.05 (1.8)	0.10 (3.9)	mm (in.x10^{-3})	T_A=25°C		1,2 6,11	6,7 8,9 10,11
			-0.05 (-2.0)	0.05 (2.0)	0.11 (4.3)		T_A = 0° to 55°C			
Space Width Error	Interior	Δs	0.04 (1.4)	-0.05 (-1.8)	-0.10 (-3.9)	mm (in.x10^{-3})	T_A=25°C		1,2 6,11	6,7 8,10 11
			0.05 (2.0)	-0.05 (-2.0)	-0.11 (-4.3)		T_A = 0° to 55°C			
Tag Scan Velocity		v_{scan}	7.6		76	cm/s			9	7
Emitter Peak Wavelength		λ		700		nm	T_A=25°C			

TYPICAL WIDTH ERROR PERFORMANCE (V_S = 5V, T_A = 25°C, R_L = 2.2kΩ, unless otherwise noted)

Parameter			Symbol	Typical WE Tilt = 0° Height = 0.25mm	Typical WE Tilt = 30° Height = 0.0mm	Units	Conditions	Fig.	Notes
Bar Width Error	From	To	Δb_1	0.08 (3.2)	0.11 (4.2)	mm (in.x10^{-3})	Margin ≥ 5mm 1b=1s=0.3mm 2b=2s=0.6mm T_A=25°C V_S=5V V_{scan}=50cm/s Preferred Orientation Standard Test Tag	1,2	5,7,8
	Margin	1st							
	1s	1b	Δb_{1-1}	0.03 (1.2)	0.04 (1.6)	mm (in.x10^{-3})		1,2	6,7,8
	2s	1b	Δb_{2-1}	0.06 (2.5)	0.07 (2.9)	mm (in.x10^{-3})		1,2	6,7,8
	1s	2b	Δb_{1-2}	0.02 (0.9)	0.02 (0.7)	mm (in.x10^{-3})		1,2	6,7,8
	2s	2b	Δb_{2-2}	0.05 (1.9)	0.05 (2.1)	mm (in.x10^{-3})		1,2	6,7,8
Space Width Error	1b	1s	Δs_{1-1}	-0.04 (-1.4)	-0.04 (-1.4)	mm (in.x10^{-3})		1,2	6,7,8
	2b	1s	Δs_{2-1}	-0.03 (-1.0)	-0.03 (-1.1)	mm (in.x10^{-3})		1,2	6,7,8
	1b	2s	Δs_{1-2}	-0.07 (-2.7)	-0.08 (-3.3)	mm (in.x10^{-3})		1,2	6,7,8
	2b	2s	Δs_{2-2}	-0.06 (-2.4)	-0.06 (-2.4)	mm (in.x10^{-3})		1,2	6,7,8

Notes:
1. Storage Temperature is dictated by Wand case.
2. Power supply ripple and noise should be less than 100 mV.
3. Switch bounce causes a series of sub-millisecond pulses to appear at the output, V_O. (HEDS-3000 only)
4. Push-to-Read switch is depressed, and the Wand is placed on a non-reflecting (black) surface. (HEDS-3000 only)
5. The margin refers to the reflecting (white) space that preceeds the first bar of the bar code.
6. The interior bars and spaces are those which follow the first bar of bar code tag.
7. The standard test tag consists of black bars, white spaces (0.3 mm, 0.012 in. min.) photographed on Kodagraph Transtar TC5® paper with a print contrast signal greater than 0.9.
8. The print contrast signal (PCS) is defined as: PCS = (R_W - R_b) /R_W, where R_W is the reflectance at 700 nm from the white spaces, and R_b is the reflectance at 700 nm for the bars.
9. 1.0 in. = 25.4 mm, 1 mm = 0.0394 in.
10. The Wand is in the preferred orientation when the surface of the label is parallel to the height dimension of the bar code.

OPERATION CONSIDERATIONS

The Wand resolution is specified in terms of a bar and space Width Error, WE. The width error is defined as the difference between the calculated bar (space) width, B, (S), and the optically measured bar (space) widths, b (s). When a constant scan velocity is used, the width error can be calculated from the following.

$B = t_b \cdot v_{scan}$

$S = t_s \cdot v_{scan}$

$\Delta b = B - b$

$\Delta s = S - s$

Where

Δb, Δs= bar, space Width Error (mm)

b, s = optical bar, space width (mm)

B, S = calculated bar, space width (mm)

v_{scan} = scan velocity (mm/s)

t_b, t_s = wand pulse width output(s)

The magnitude of the width error is dependent upon the width of the bar (space) preceeding the space (bar) being measured. The Guaranteed Width Errors are specified as a maximum for the margin to first bar transition, as well as, maximums and minimums for the bar and space width errors resulting from transitions internal to the body of the bar code character. The Typical Width Error Performance specifies all possible transitions in a two level code (e.g. 2 of 5). For example, the $\Delta b_{2\to1}$ Width Error specifies the width error of a single bar module (0.3 mm) when preceeded by a double space module (0.6 mm).

The Bar Width Error Δb, typically has a positive polarity which causes the calculated bar, B, to appear wider than its printed counterpart. The typical negative polarity of the Space Width Error Δs, causes the measured spaces to appear narrower. The consistency of the polarity of the bar and space Width Errors suggest decoding schemes which average the measured bars and measured spaces within a character. These techniques will produce a higher percentage of good reads.

The Wand will respond to a bar code with a nominal module width of 0.3 mm when it is scanned at tilt angles between 0° and 30°. The optimum performance will be obtained when the Wand is held in the preferred orientation (Figure 1), tilted at an angle of 10° to 20°, and the Wand tip is in contact with the tag. The Wand height, when held normal to the tag, is measured from the tip's aperture, and when it is tilted it is measured from the tip's surface closest to the tag. The Width Error is specified for the preferred orientation, and using a Standard Test Tag consisting of black bars and white spaces. Figure 2 illustrates the random two level bar code tag. The Standard Test Tag is photographed on Kodagraph Transtar TC5® paper with a nominal module width of 0.3 mm (0.012 in.) and a Print Contrast Signal (PCS) of greater than 90%.

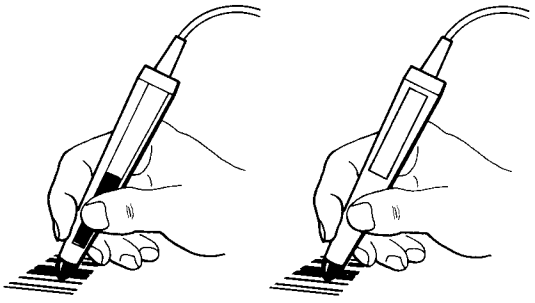
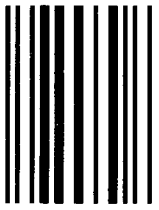


Figure 1. Preferred Wand Orientation.



BAR WIDTH 0.3 mm (0.012 in.) BLACK & WHITE

R_{WHITE} > 75%, PCS > 0.9 KODAGRAPH TRANSTAR TC5® PAPER

Figure 2. Standard Test Tag Format.

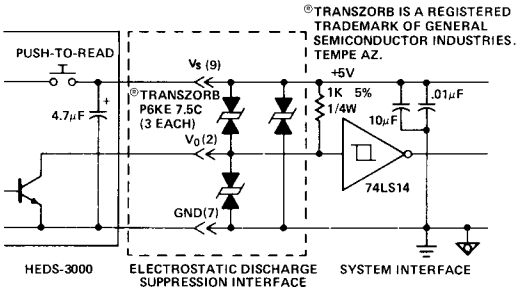


Figure 3a. Recommended Logic Interface for HEDS-3000

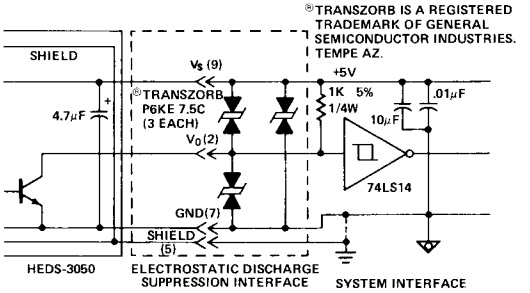


Figure 3b. Recommended Logic Interface for HEDS-3050. (When earth ground is not available, connect shield to logic ground, as shown by dotted line)

Typical Performance Curves (R_L = 2.2kΩ)

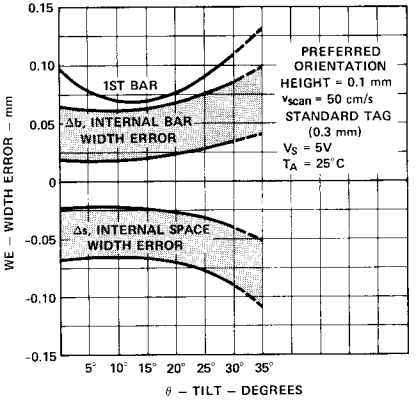


Figure 4. Width Error vs. Tilt (Preferred Orientation).

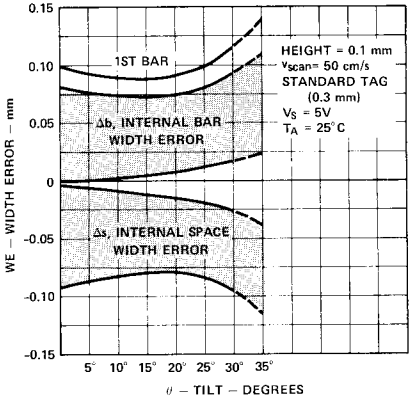


Figure 5. Width Error vs. Tilt (Any Orientation).

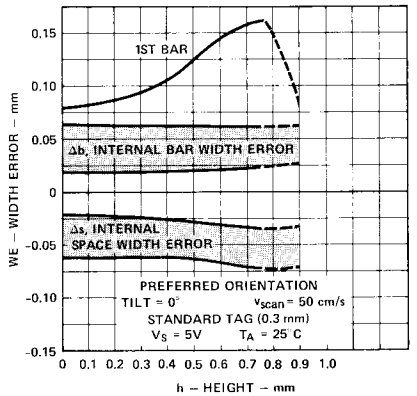


Figure 6. Width Error vs. Height (Preferred Orientation).

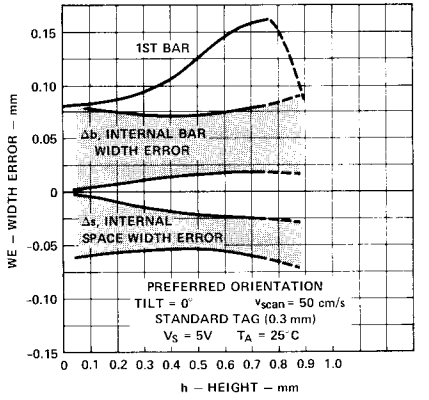


Figure 7. Width Error vs. Height (Any Orientation).

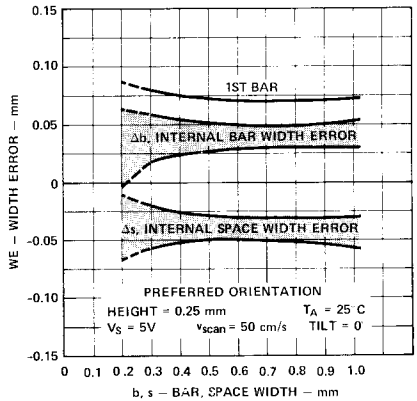


Figure 8. Width Error vs. Bar Width.

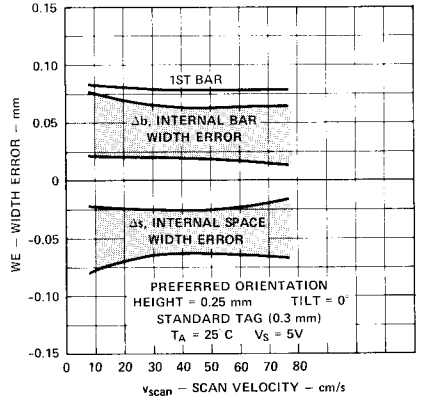


Figure 9. Width Error vs. Scan Velocity.

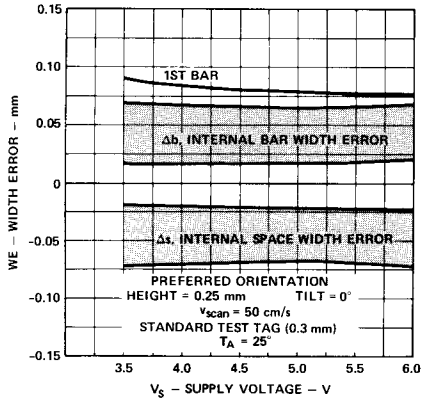


Figure 10. Width Error vs. Supply Voltage.

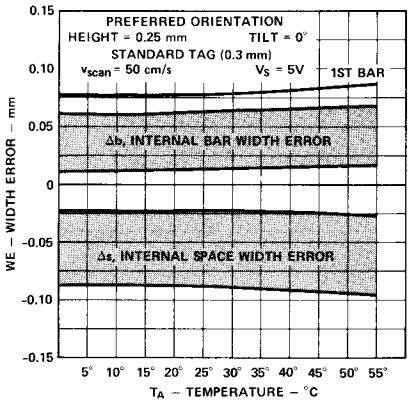


Figure 11. Width Error vs. Temperature.

MECHANICAL CONSIDERATIONS

The HEDS-3000/-3050 include a standard nine pin D-style connector with integral squeeze-to-release retention mechanism. Two types of receptacles with the retention mechanism are available from AMP Corp. (Printed circuit header: 745001-2 Panel mount: 745018, body; 66570-3, pins). Panel mount connectors that are compatible with the Wand connector, but do not include the retention mechanism, are the Molex A7224, and AMP 2074-56-2.

MAINTENANCE CONSIDERATIONS

While there are no user serviceable parts inside the Wand, the tip should be checked periodically for wear and dirt, or obstructions in the aperture. The tip aperture is designed to reject particles and dirt but a gradual degradation in performance will occur as the tip wears down, or becomes obstructed by foreign materials.

Before unscrewing the tip, disconnect the Wand from the system power source. The aperture can be cleaned with a cotton swab or similar device and a liquid cleaner.

The glass window on the sensor should be inspected and cleaned if dust, dirt, or fingerprints are visible. To clean the sensor window dampen a lint free cloth with a liquid cleaner, then clean the window with the cloth taking care not to disturb the orientation of the sensor. DO NOT SPRAY CLEANER DIRECTLY ON THE SENSOR OR WAND.

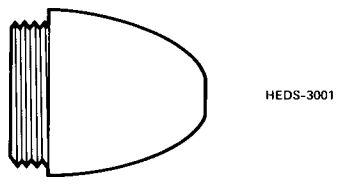


Figure 12. Wand Tip.

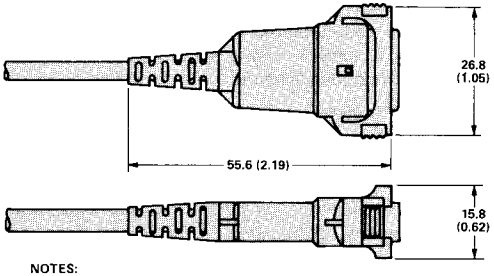
After cleaning the tip aperture and sensor window, the tip should be gently and securely screwed back into the Wand assembly. The tip should be replaced if there are visible indications of wear such as a disfigured, or distorted aperture. The part number for the Wand tip is HEDS-3001. It can be ordered from any franchised Hewlett-Packard distributor.

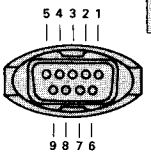
OPTIONAL FEATURES

The wand may also be ordered with the following special features:

- Special colors
- Customer specified label
- No label
- Heavy duty retractable coiled cord
- No connector
- With/without switch button

For more information, call your local Hewlett-Packard sales office or franchised distributor.





Pin	Wire Color	HEDS-3000 Function	HEDS-3050 Function
1	NC	NC	NC
2	White	V_O Output	V_O Output
3	NC	NC	NC
4	NC	NC	NC
5	—	NC	Shield
6	NC	NC	NC
7	Black	Ground	Ground
8	NC	NC	NC
9	Red	V_S Supply Voltage	V_S Supply Voltage

Figure 13. Connector Specifications.