

# **LOW POWER SHIFT-OUT INTELLIHEAD USER MANUAL**

**Specification Part Number 99875349-4**

**MARCH 2009**

**MAGTEK<sup>®</sup>**  
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## REVISIONS

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1	18 Jan 07	Initial Release
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3	1 Oct 08	Updated address; Updated drawings and added 21030041, 21044013, 21045092, 21047021
4	23 Mar 09	Changed low swipe speed spec from 3 to 6IPS, add 21030031, Added Warranty and Agency Approval information.

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### **FCC COMPLIANCE STATEMENT**

This device complies with Part 15 of the FCC Rules. Operation of this device is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

### **CANADIAN DOC STATEMENT**

This digital apparatus does not exceed the Class B limits for radio noise from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe B prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.


### **CE STANDARDS**

Testing for compliance with CE requirements was performed by an independent laboratory. The unit under test was found compliant with standards established for Class B devices.

### **UL/CSA**

This product is recognized per Underwriter Laboratories and Canadian Underwriter Laboratories 1950.

### **RoHS STATEMENT**

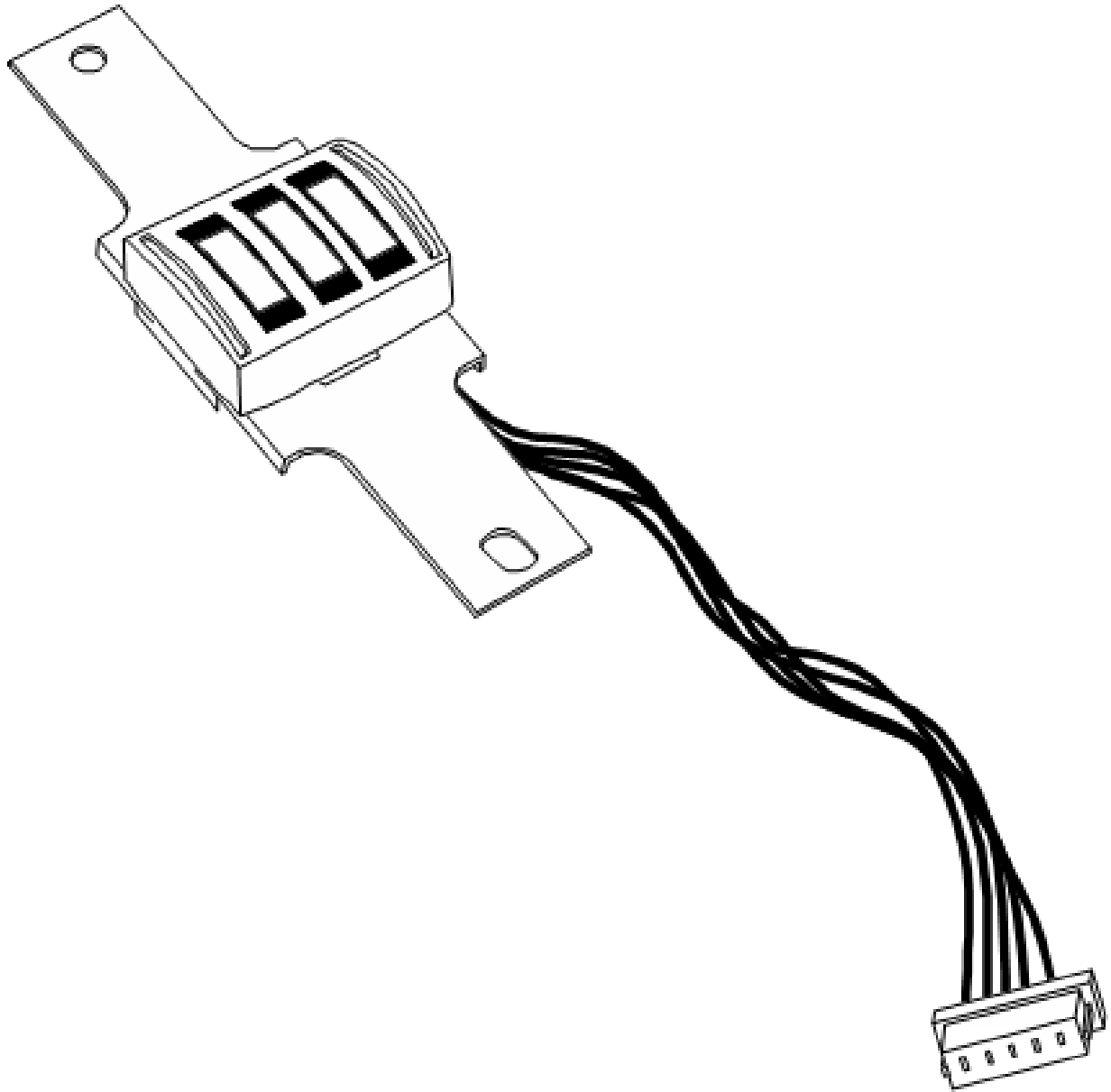
When ordered as RoHS compliant, this product meets the Electrical and Electronic Equipment (EEE) Reduction of Hazardous Substances (RoHS) European Directive 2002/95/EC. The marking is clearly recognizable, either as written words like "Pb-free", "lead-free", or as another clear symbol (  ).

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**Figure 1. Low Power Shift-Out IntelliHead**

## INTRODUCTION

MagTek's **Low Power Shift-Out IntelliHead** consists of a high-performance multi-channel fully integrated magnetic stripe decoder chip *encapsulated within* a low-profile magnetic read-head. The **Low Power Shift-Out IntelliHead** is designed for battery operated devices that need to “wake from swipe”. It features a typical quiescent current when armed to accept a swipe of only **1.5  $\mu$ A**. If this low quiescent current is not needed, then cost savings can be realized by using the regular **Shift-Out IntelliHead**. See MagTek specification 99875258 for details.

Note that the **Low Power Shift-Out IntelliHead** is limited to reading cards that have at least track 2 encoded. This is because it keys off of track 2 only for its “wake-up” signal. If track 2 is encoded, the other encoded tracks (track 1 and/or track 3) will also be read.

## FEATURES

- **Ultra-low Sleep or Armed-to-Read current** – only **1.5  $\mu$ A** typical current when no card is being swiped. Ideal for battery-powered readers.
- **Ultra-compact design** – low-profile read head contains all needed circuits. Save PCB space!
- **No external components** – even the decoupling capacitor is integrated. Only 4 signals, VDD, VSS, DATA, and STROBE to connect to your micro-controller for up to 3 tracks
- **Data buffer with Shift-Out** – allows full card data to be locally stored on ASIC. Use a low-power controller with interrupt on swipe, limited memory, low-speed, low pin-count, etc.
- **High noise immunity** – no analog signals leave the shielded magnetic head! Withstands noisy PC monitors, cell phones, switching power supplies, etc.
- **High performance decoding** – new design reads badly damaged cards; compensates for poor head mounting
- **Robust re-synchronization capabilities** – reads cards with badly damaged leading or synchronization zero-bits in either swipe direction
- **Low voltage operation** – 2.85 V to 3.6 V
- **Low operating current** – less than 1.2 mA maximum total current at 3.3V (for up to 3 tracks) while card is being swiped
- **AGC (Automatic Gain Control)** – reads cards from 30% - 200% of ISO 7811 amplitude standard
- **Wide operational temperature range** – -40 °C to +85 °C
- **Wide range of card swipe speeds** – from 6 ips to 100 ips (15 cm/s to 250 cm/s)
- **ROHS Compliant** – “lead (Pb) free” component

## CONFIGURATIONS

These are the low power Shift-Out IntelliHead models. Each model includes the ability to read all 3 tracks of data and is supplied with a 5-pin Molex connector (51021-0500). The reader configurations and available wire lengths are indicated in the table.

<b>Part Number</b>	<b>Description</b>	<b>Wire Length</b>
21030028	Butterfly spring for 90/100mm swipe readers	125mm
21030031	Cantilever Arm, left	125mm
21030036	4.05mm beam arm for insert readers	125mm
21030041	Spring for 43mm rail	125mm
21044013	43mm reader, no covers	100mm
21045092	90mm reader, no covers	80mm
21047021	90mm Slim profile reader, no covers	125mm

## REFERENCE DOCUMENTS

*Magnetic Card Reader Design Kit Technical Specification, P/N 99821002*

*Triple Track ASIC With Shift-Out, 3V, Specifications, P/N 99875337*

*Shift-Out IntelliHead 3V & 5V User Manual, P/N 99875258*



## SHIFT-OUT PROTOCOL

**Refer to MagTek specification 99875337 for details of the Shift-Out Protocol. The Low Power Shift-Out IntelliHead functions identically to the regular Shift-Out IntelliHead, except as noted in this document. This document (99875349) takes precedence over 99875337.**

The exact same Shift-Out protocol (New Mode) for the regular Shift-Out IntelliHead *may* also be used for the Low Power Shift-Out IntelliHead. To take advantage of the low power feature, though, a special protocol must be followed. This special protocol delays the reset sequence by 300 ms, so it can be advantageous to use the regular Shift-Out protocol when a quick re-arm time is desired. This is typically the case for insert or dip type readers. A quick reset is needed if it is desired to read on withdrawal of the card. Note that this imposes no penalty on battery life, since after the card withdrawal, the IntelliHead may be put back into the low power armed-to-read state with the special protocol.

To put the unit in its special low power armed-to-read state, after STROBE is taken high entering the OFF state as a part of the reset sequence, delay at least 300 ms, and then take STROBE from its high state to a high-impedance state (high-Z). The unit is now in its special low power armed-to-read state, although the Delta ASIC internal to the Low Power IntelliHead is in its OFF state.

When in the special low power armed-to-read state, the Low Power IntelliHead will only respond to the track 2 signal for “wake-up”. Once “awakened”, tracks 1 and/or 3 will be read if encoded. Cards that do not have track 2 encoded will not read reliably. They may read sometimes due to some DC magnetization of the intended blank track 2 stripe causing a sufficiently large signal to trip the “wake-up” circuit.

From the special low power armed-to-read state, STROBE will fall when a card is detected. STROBE will remain low for at least 100ms<sup>1</sup>. The user’s micro-controller must actively drive STROBE low (even though it is being driven low by the IntelliHead) within this 100ms window. STROBE should be push-pull now until it is again set to high-Z at the end of the next special reset sequence. If the 100ms window is missed, indeterminate operation may result, and another reset should be performed.

From the falling edge of STROBE signaling the beginning of a card swipe, the MCU must hold STROBE low and wait for DATA to fall, indicating the Card-Present (CP) condition. If there is no CP within 30ms, a reset should be performed. If CP is seen within 30ms, then operation should proceed as detailed in 9875337 for the remainder of the shift-out sequence.

The information below is needed for the firmware designer to assign the memory-tracks of the ASIC (A, B, and C) to the physical magnetic head tracks (1, 2, and 3).

The on-chip memory tracks of the Low Power Shift-Out IntelliHead are permanently assigned to particular tracks of the magnetic head via internal wires connecting the head coil wires to particular inputs of the built-in ASIC. As it is oriented in Figure 3, tracks ‘A’, ‘B’, and ‘C’ of the internal ASIC correspond to tracks ‘1’, ‘2’, and ‘3’ of the reader respectively. The IntelliHead may be mounted with the opposite orientation if desired, but firmware must anticipate this re-mapping of ASIC memory tracks to physical magnetic head tracks.

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<sup>1</sup> If compatibility with the future MagnePrint™ Low Power IntelliHead is desired, a 25  $\mu$ s window should be respected instead of a 100 ms window. MagnePrint is a security feature that can distinguish counterfeit cards from the original card.

## CURRENT CONSUMPTION †

Note: Refer to the timing diagrams in 99875337 for complete information.

$I_{arm}$  = 120  $\mu$ A maximum

$I_{swipe}$  = **1.2 mA** maximum (internal oscillator running)

$I_{extract}$  = 20  $\mu$ A maximum

$C_{strb}$  = [1 nF maximum + parasitic capacitance of PCB] (this is the total capacitance driven by **STROBE** and its effects; sometimes called power-dissipation-capacitance)

$F_{strb}$  = User-controlled frequency of **STROBE** during data extraction

$I_{dataLow}$  = 48  $\mu$ A maximum

$I_{rst\_int}$  = **1.2 mA** maximum (internal oscillator running; subtract  $I_{dataLow}$  if **DATA** is released before  $I_{rst\_int}$  expires)

$I_{off}$  = **1.5  $\mu$ A typical at 25 °C; 13  $\mu$ A maximum at 85 °C (STROBE drive leakage into MCU not included)**

Example calculation for current consumption during New Mode data extraction:

Maximum parasitic PCB capacitance on **STROBE** (example) = 20 pF

$C_{strb}$  = 1 nF + 20pF

$F_{strb}$  = 1MHz

VDD = 3.3 V

$I_{max}$  =  $I_{extract}$  +  $F_{strb}$  \*  $C_{strb}$  \* VDD

$I_{max}$  = (20  $\mu$ A) + (1 MHz) \* (1020 pF) \* (3.6 V)

$I_{max}$  = 3.7 mA

### Notes:

- 1) **The duration of  $I_{arm}$  is very brief when using the low power armed-to-read feature. It exists only from the time STROBE falls at the beginning of a card, until the time that the ASIC is able to recognize the card. This duration is one bit-cell maximum (swipe speed dependent).**
- 2) **When treating this unit as a regular Shift-Out IntelliHead, an additional current of up to 190 $\mu$ A will exist in the armed-to-read state ( $I_{arm}$ ) due to a 20 k $\Omega$  nominal pull-up in the Low Power Shift-Out IntelliHead. Except in the armed-to-read state, this 20 k $\Omega$  nominal resistor may be a pull-up or pull-down depending upon actual head signals.**

† Red font indicates a difference relative to 99875337.

## SHIFT-OUT TIMING

Refer to MagTek specification 99875337 for details of the Shift-Out Timing. The following exception exists for the IntelliHead in contrast to the ASIC specification given in 99875337.

*Trst* (Reset) = 1.5 ms minimum (not shown in timing diagram)

VDD off-time to guarantee a reset for the ASIC/Head unit. This is due to an RC power supply filter inside the head.

Other differences exist when using the special low power armed-to-read state. These are detailed in the [SHIFT-OUT PROTOCOL](#) section above.

# TECHNICAL SPECIFICATIONS

## Absolute Maximum Ratings †

Parameter	Conditions (-40°C to +85°C unless otherwise stated)	Value	Units
V <sub>DD</sub>	Steady-state	-0.3 to 4.0V	V
STROBE Input Voltage	Steady-state	-0.3 to V <sub>DD</sub> +0.3	V
STROBE Protection Diode Current	Steady-state	-20 to 20	
DATA Input Voltage	Steady-state	-0.3 to V <sub>DD</sub> +0.3	V
DATA Protection Diode Current	Steady-state	-20 to 20	mA
DATA Output Current Sourcing	Steady-state	Internally limited	
DATA Output Current Sinking	Steady-state	20	mA
Storage Temperature	Steady-state	-55 to <b>100</b>	°C
ESD Immunity*	Human Body Model, JESD22-A114-A, class 2	<b>NOT TESTED</b>	V
ESD Immunity*	Machine Model, JESD22-A115-A, class 2	<b>NOT TESTED</b>	V
ESD Immunity*	Charge Device Model, ESD-STM5.3.1-1999, classification C3	<b>NOT TESTED</b>	V
Latch-up Immunity	85 °C, EIA/JESD78	<b>NOT TESTED</b>	mA

\* ESD Immunity refers to a pin-to-pin discharge (not to discharges to the head can). The 5V-to-3V Shift-Out IntelliHead contains other components in addition to the Delta ASIC (21006541), so the ESD rating of 21006541 is not necessarily applicable.

† Red font indicates a difference relative to 99875337.

## Electrical Characteristics and Recommended Operating Conditions †

Parameter	Conditions (-40 °C to +85 °C)	Value		Units
		Min	Max	
V <sub>DD</sub> Operating		<b>2.85</b>	3.6	V
V <sub>DD</sub> Time Constant	To guarantee proper reset functioning under all conditions; <b>Not needed; already built-in.</b>	<b>0</b>		
I <sub>DD</sub>	See "Current Consumption" section		<b>1.2</b>	mA
V <sub>OL</sub> DATA	V <sub>DD</sub> = <b>2.85</b> V; I <sub>OL</sub> = 2 mA		0.40	V
I <sub>OH</sub> DATA	V <sub>DATA</sub> = 0 V to 0.85*V <sub>DD</sub> ; Steady-state	12	48	µA
V <sub>IH</sub> DATA			0.80* V <sub>DD</sub>	V
V <sub>IL</sub> DATA		0.20* V <sub>DD</sub>		V
VT+ STROBE	Positive-going threshold	0.40* V <sub>DD</sub>	0.80* V <sub>DD</sub>	V
VT- STROBE	Negative-going threshold	0.20* V <sub>DD</sub>	0.40* V <sub>DD</sub>	V
<b>STROBE PULL-UP/DWN</b>	<b>STROBE driver must meet the above threshold constraints while driving this resistance to VDD or to ground.</b>	<b>18</b>		<b>kΩ</b>
Hysteresis STROBE	VT+ - VT-	0.4	1.2	V
<b>STROBE Driver Leakage</b>	<b>Leakage constraint for MCU STROBE Driver when in high-Z state with STROBE pulled high by the IntelliHead.</b>	<b>N/A</b>	<b>10</b>	<b>µA</b>
C <sub>LOAD</sub> DATA‡			50	pF
<b>Electrostatic Discharge</b>	<b>ESD to head-can with head-can well-grounded; 150 pF and 330 Ω network</b>	<b>-15</b>	<b>+15</b>	<b>kV</b>

‡ Exceeding CLOAD Max DATA will affect the maximum rate of DATA.

† Red font indicates a difference relative to 99875337.

**Mechanical**

Dimensions	As shown in the Figures at the end of this document
Life	1,000,000 Passes

**Environmental**

Operating Environment Temperature	-40 °C to +85 °C (-40 °F to +185 °F)
Relative Humidity	10% to 90% non-condensing
Storage Environment Temperature	-40 °C to +100 °C (-40 °F to +212 °F)
Relative Humidity	10% to 90% non-condensing

# PACKAGING, WIRING, AND MOUNTING

## Packaging and Pin Assignments

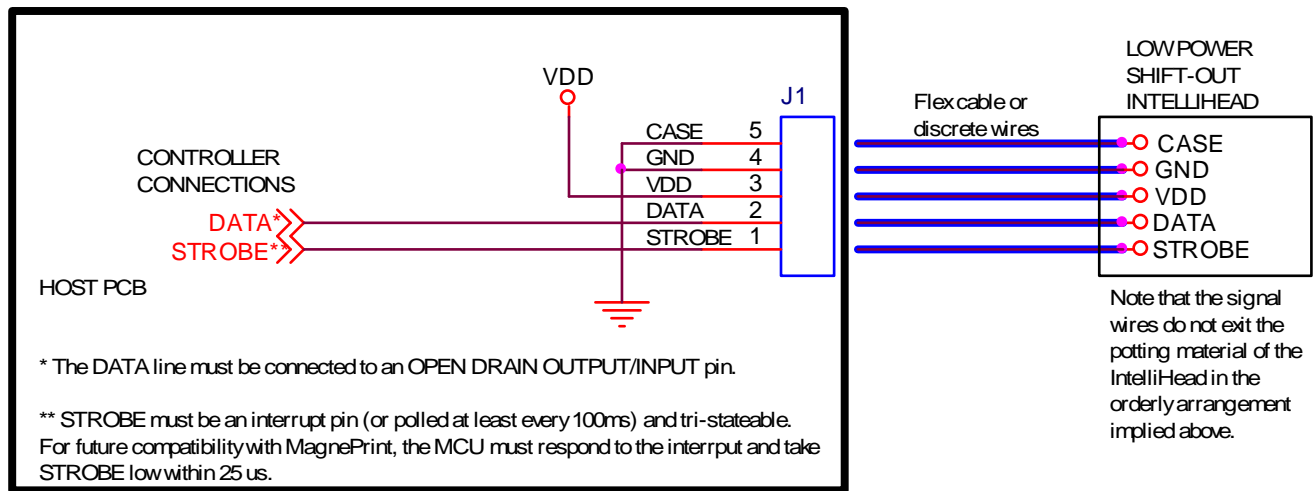
Signal and pin assignments for the Low Power Shift-Out IntelliHead connector (51021-0500) are shown in Table 1.

**Table 1. Signal and Pin Assignments – IntelliHead**

Pin Number	Description
1	STROBE
2	DATA
3	VDD
4	GND
5	CASE

## Wiring

The Low Power Shift-Out IntelliHead Wiring Diagram is shown in Figure 2. The recommended mating connector is **Molex 53048-0510**.



Head case ground shown connected to signal ground via the IntelliHead connector. It is better to connect the head case ground directly to a separate earth ground if possible, bypassing the closely spaced PCB connector terminals. If this is not possible, as is the case in many designs, then the next best thing is to pass the earth ground through the board on its way to earth. Tying earth ground to signal ground on the PCB is often done, but problems can arise in the case of extreme ESD events.

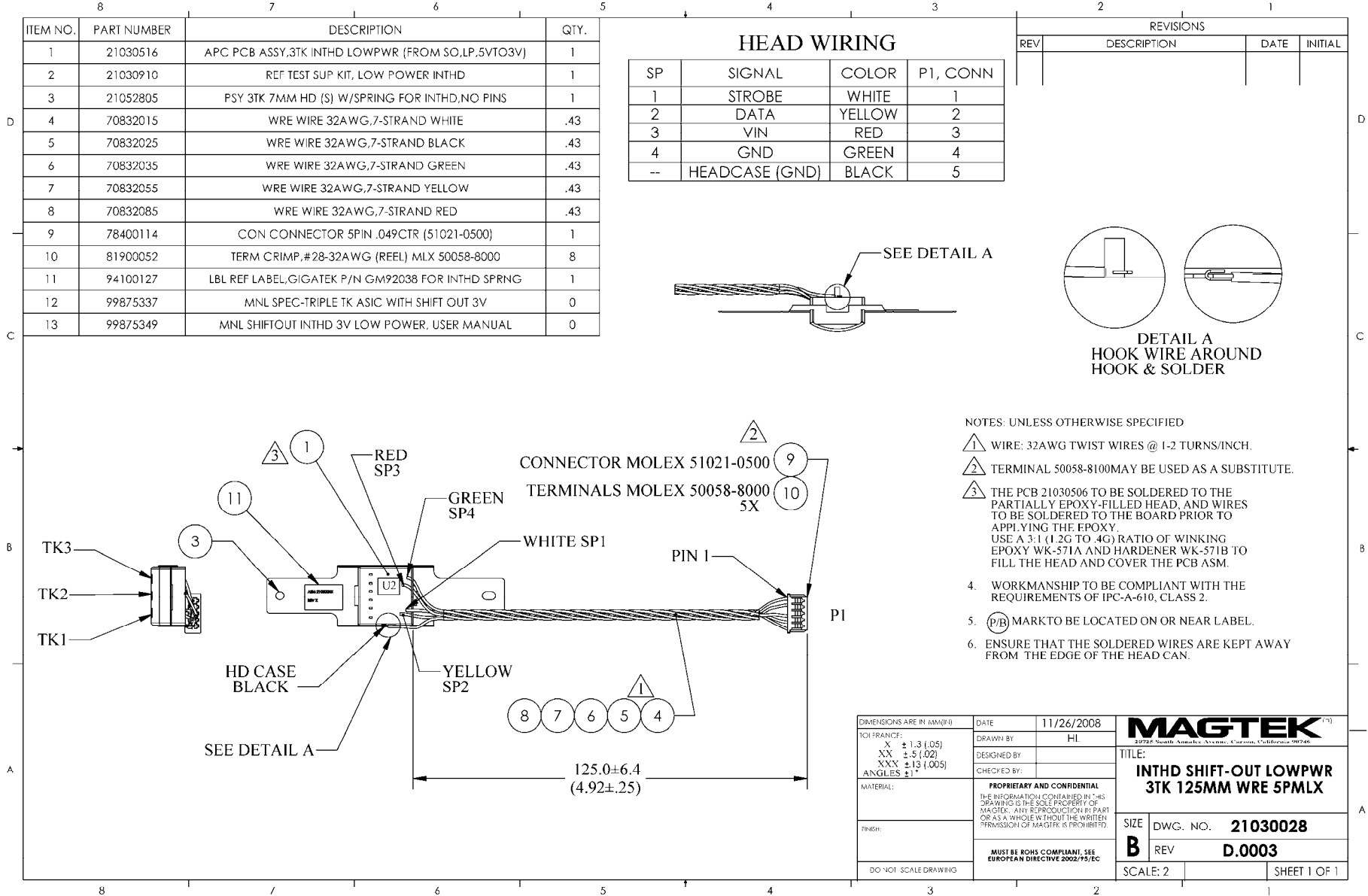
**Figure 2. Low Power Shift-Out IntelliHead Wiring**

## Mounting

The Low Power Shift-Out IntelliHead drawing is shown in Figure 3.

Refer to the Reader Design Kit Specification, P/N 99821002, for complete mechanical mounting information.

**Low Power Shift-Out IntelliHead**



**Figure 3. Low Power Shift-Out IntelliHead 90mm Butterfly Spring**

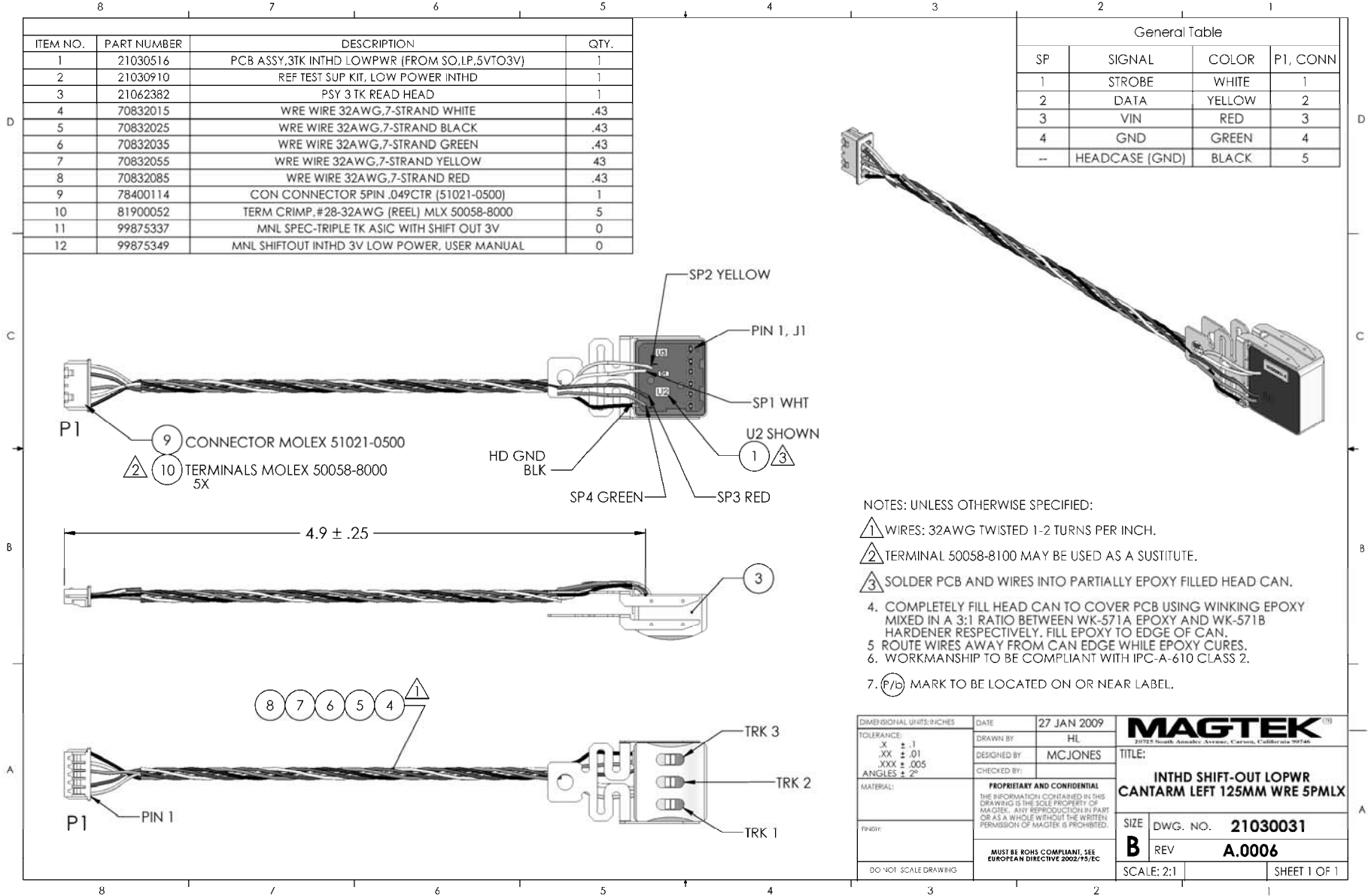


Figure 4. Low Power Shift-Out IntelliHead 125mm Cantilever Arm, Left



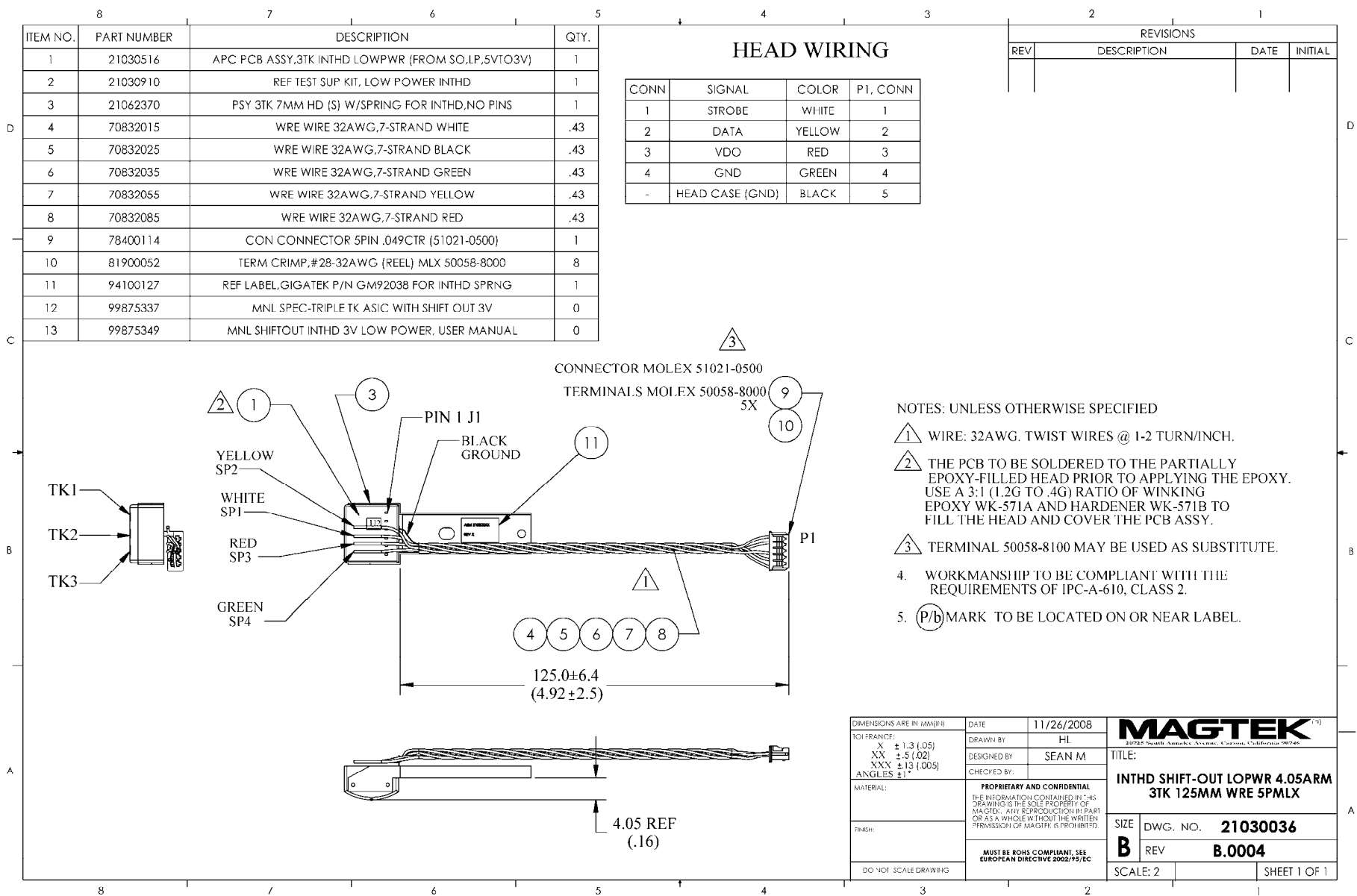


Figure 5. Low Power Shift-Out IntelliHead 4.05mm Beam Arm

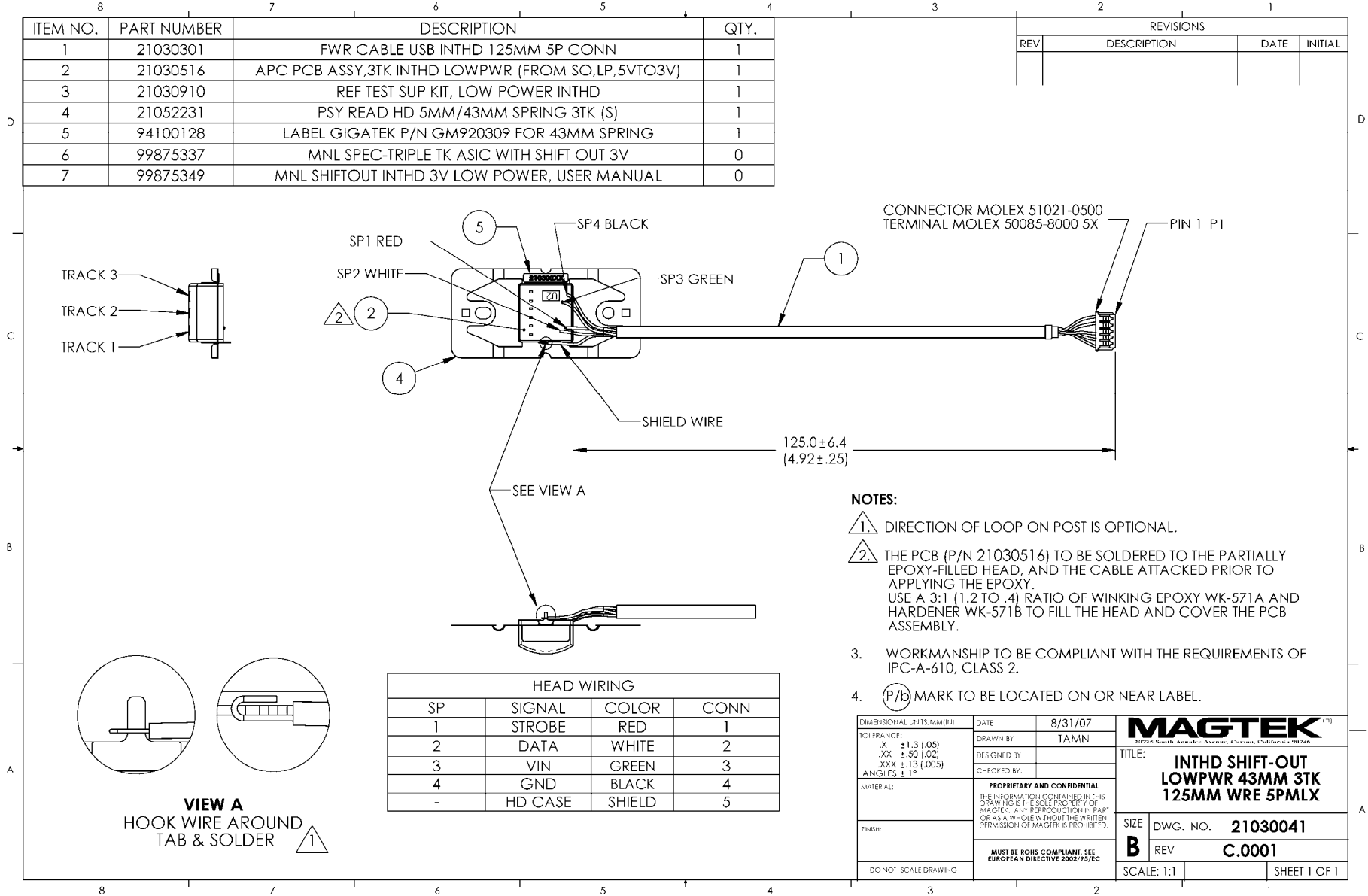


Figure 6. Low Power Shift-Out IntelliHead 43mm Spring

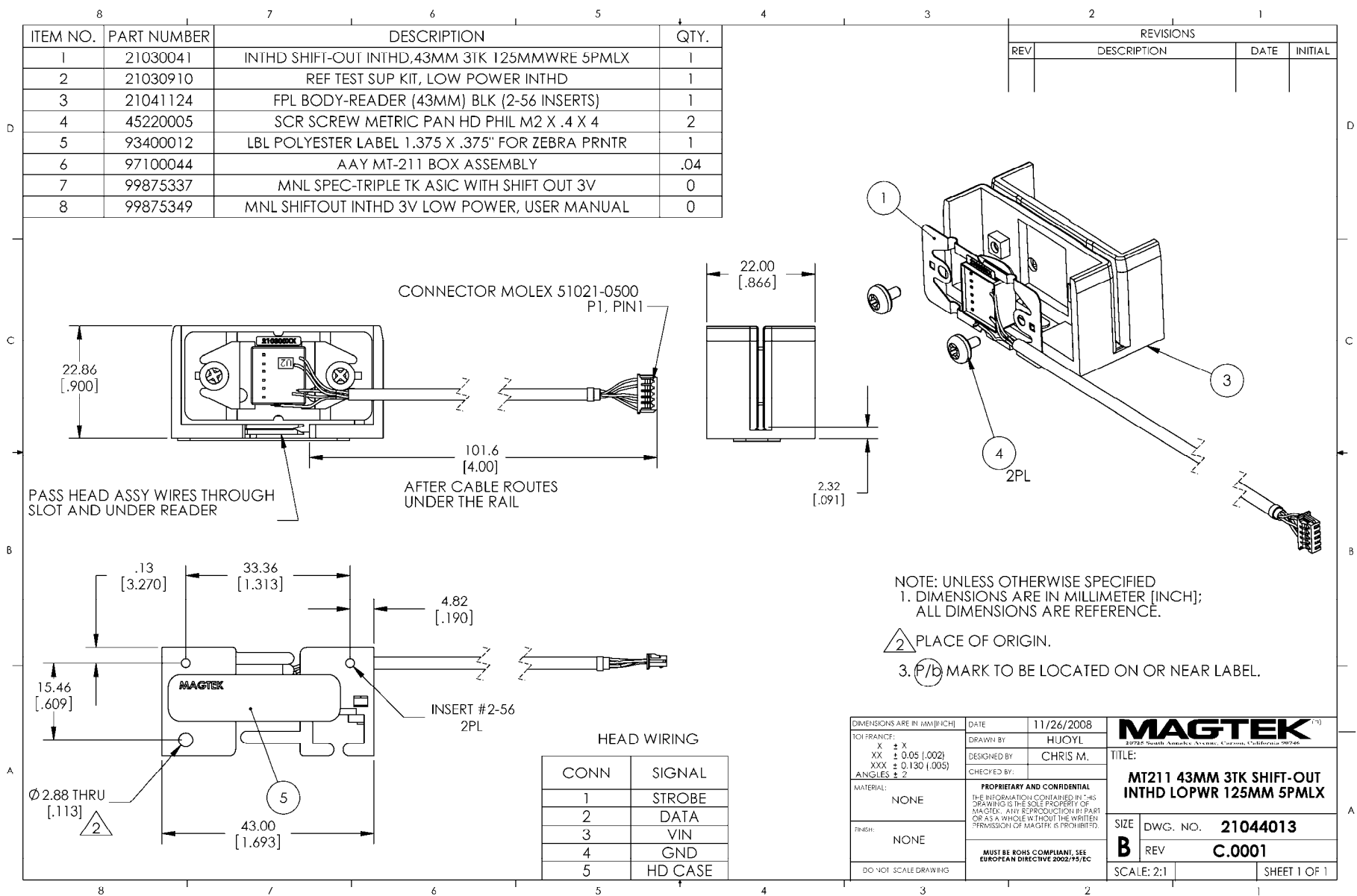


Figure 7. 43mm 3 Track Low Power Shift-Out IntelliHead

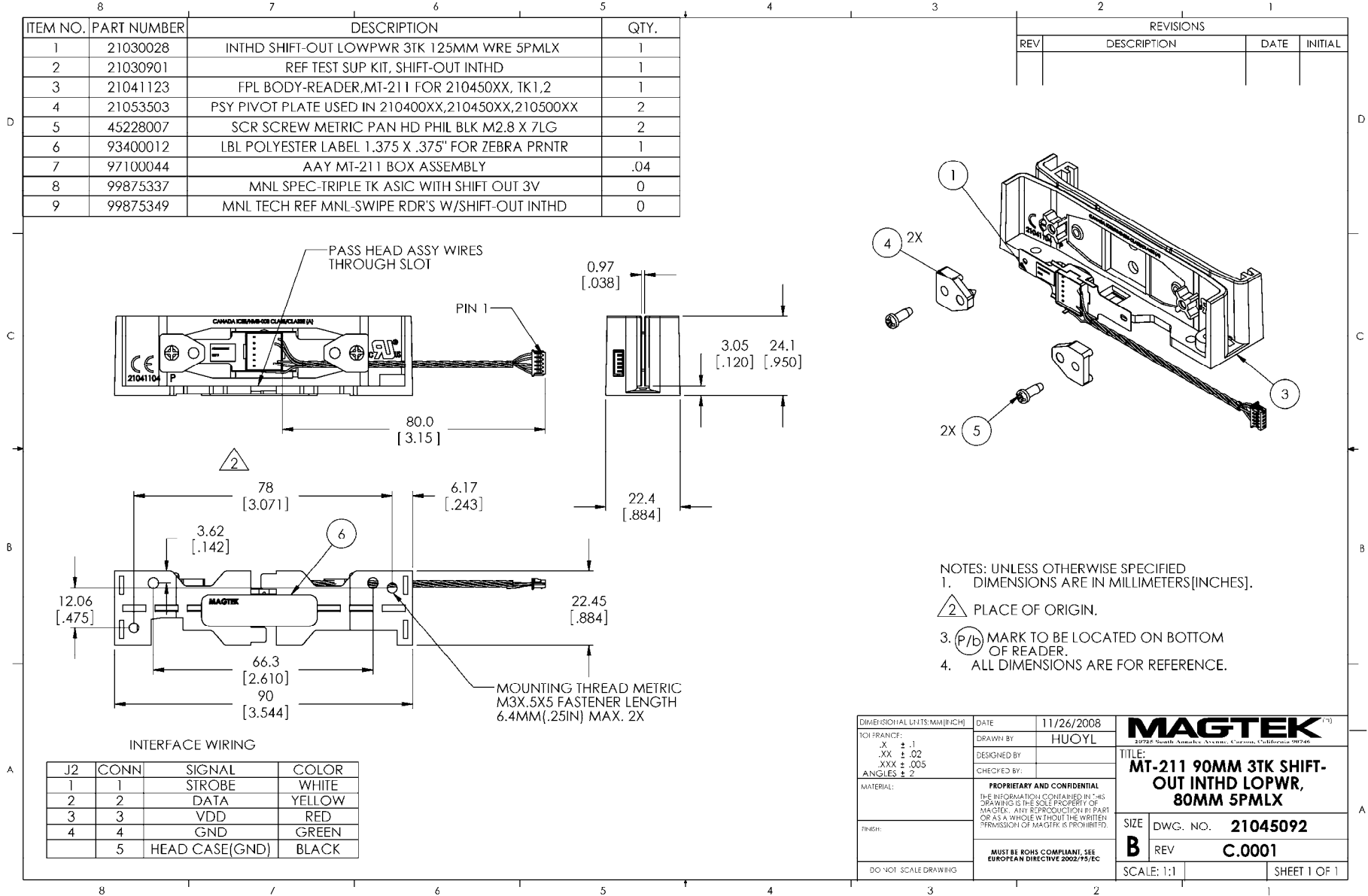


Figure 8. 90mm 3 Track Low Power Shift-Out IntelliHead

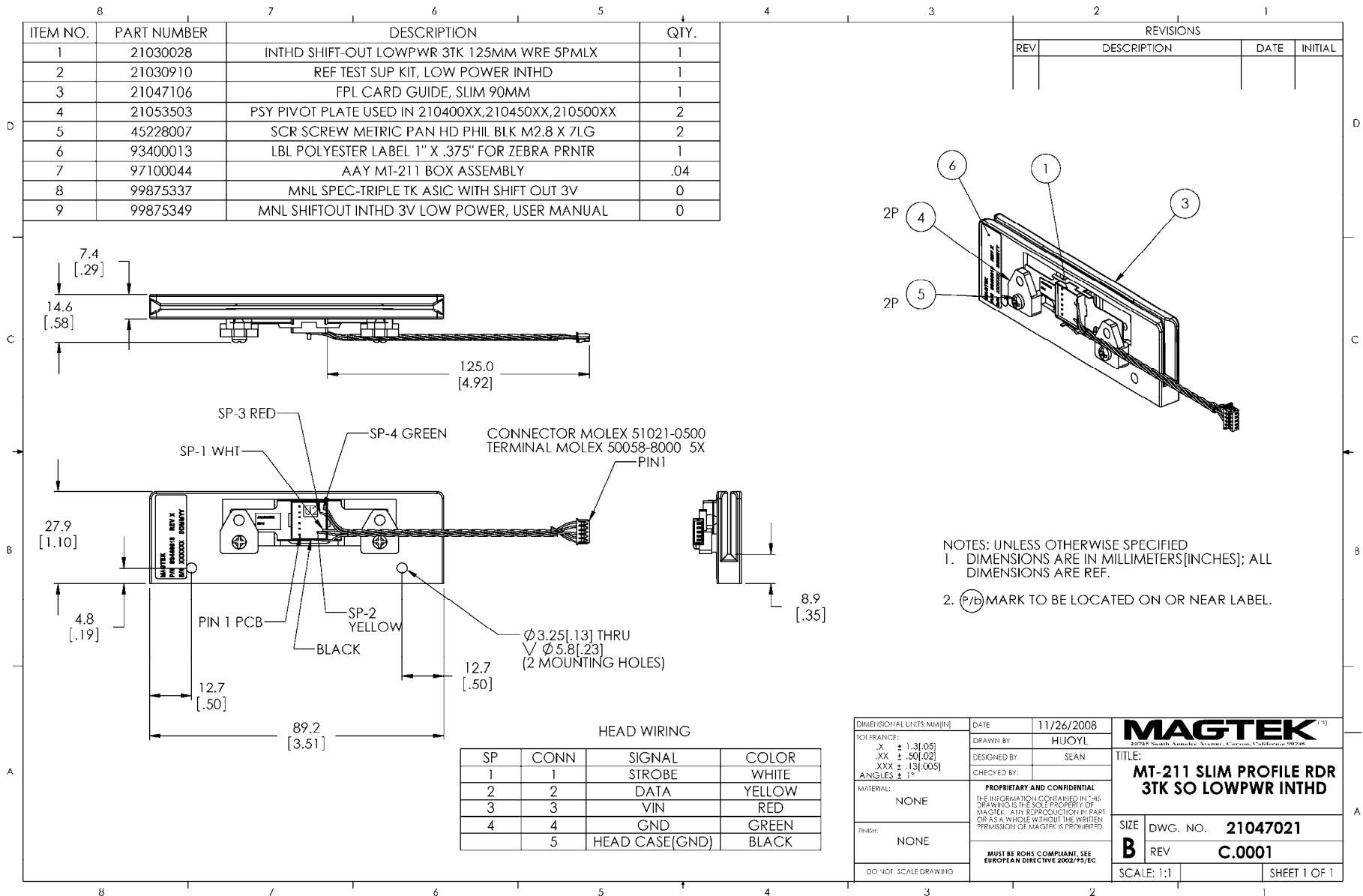


Figure 9. Slim Profile 3 Track Low Power Shift-Out IntelliHead