



Optimum L4100

Magnetic Stripe Card Reader Proven Reliability

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Hypercom Optimum terminals have been designed to provide long life and reliable operation in the Multi-Lane retail setting, despite the sometimes-harsh environmental conditions. During the month of August 2005, Hypercom completed a continuing engineering review and periodic testing of the Optimum L4100 payment terminal. This review took into account customer experiences and reports of performance in live, full production environments. One aspect of this review focused on the Magnetic Stripe Reader and the supporting software.

Background Information

The Hypercom L4100 is configured with a 3-track Magnetic Stripe Reader. Optionally, the device contains two such readers, located on opposite sides of the card track, to ensure first-time card read regardless of card orientation. At the time of our investigation, all customers purchasing the Optimum L4100 had purchased the dual-reader configuration.

Track 1 contains more data and is compressed to a greater extent than Track 2 data. Additional data on Track 1 includes the Cardholder Name, CVV data, and etc.¹

Card Data Format - Track 1

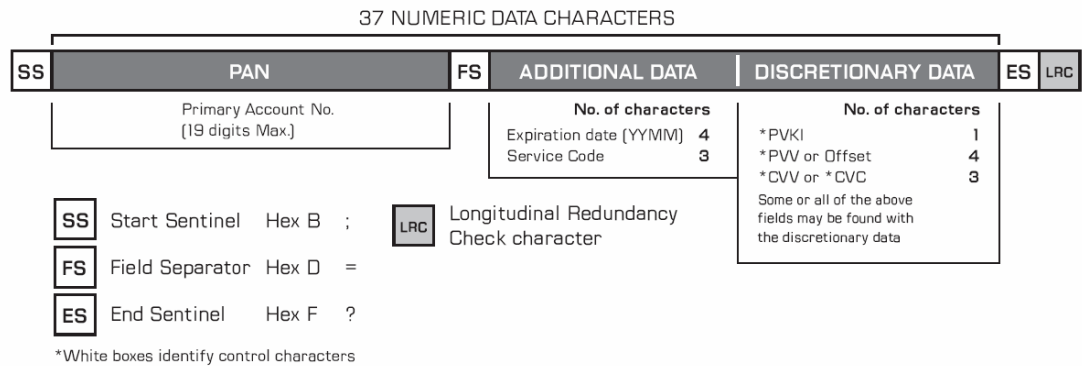
76 ALPHANUMERIC DATA CHARACTERS																									
SS	FC	PAN	FS	NAME	FS	ADDITIONAL DATA	DISCRETIONARY DATA	ES	LRC																
		Primary Account No. (19 digits Max.)		Name (26 alphanumeric characters Max.)		<table border="1"> <tr><th colspan="2">No. of characters</th></tr> <tr><td>Expiration date [YYMM]</td><td>4</td></tr> <tr><td>Service Code</td><td>3</td></tr> </table>	No. of characters		Expiration date [YYMM]	4	Service Code	3	<table border="1"> <tr><th colspan="2">No. of characters</th></tr> <tr><td>*PVKI</td><td>1</td></tr> <tr><td>*PVV or Offset</td><td>4</td></tr> <tr><td>*CVV or *CVC</td><td>3</td></tr> <tr><td colspan="2">Some or all of the above fields may be found with the discretionary data</td></tr> </table>	No. of characters		*PVKI	1	*PVV or Offset	4	*CVV or *CVC	3	Some or all of the above fields may be found with the discretionary data			
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Some or all of the above fields may be found with the discretionary data																									
SS	Start Sentinel	%		FC	Format Code																				
FS	Field Separator	^		LRC	Longitudinal Redundancy Check character																				
ES	End Sentinel	?																							

¹Courtesy of MagTek (www.magtek.com)



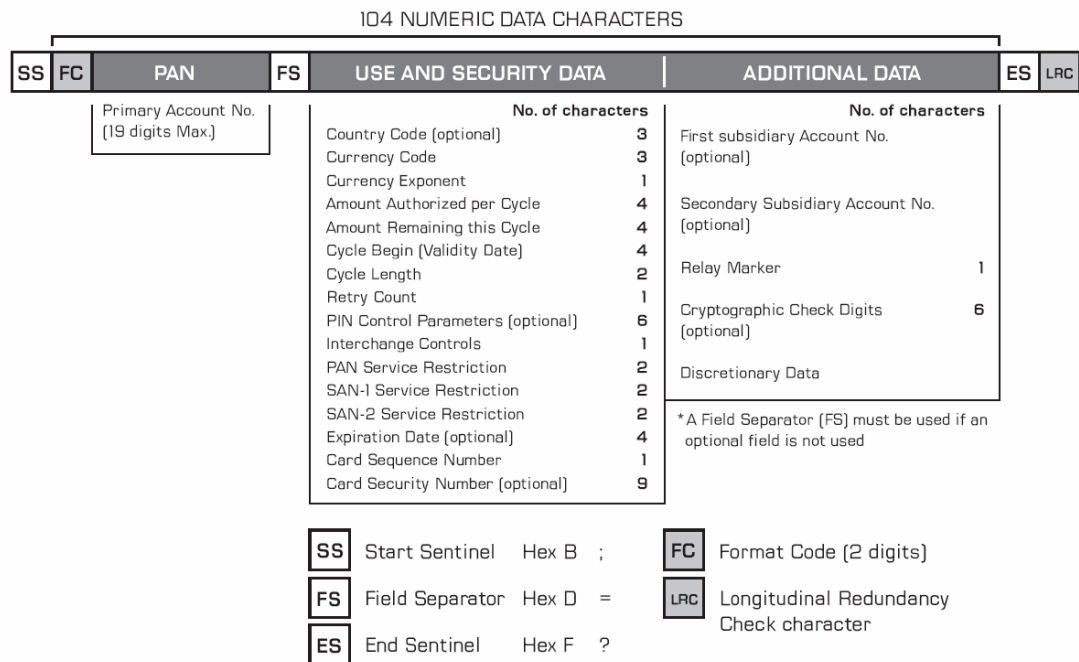
Track 2 data is far less compressed than Track 1 data. Track 2 is generally the “preferred data” for transactions, and contains only the Card Number, Expiration Date, and a minor amount of discretionary data. Historically, Track 2 data is more reliably read than Track 1 data due to the significantly lower compression of information contained on it.²

Card Data Format - Track 2



Track 3 data is non-Credit/Debit related, and generally used for Drivers License information or specialized card programs such as Loyalty, Stored Value, etc.²

Card Data Format - Track 3 (ISO 4909)



²Courtesy of MagTek (www.magtek.com)



MSR cards are encoded with binary data within the tracks. This binary data is encoded on the card in what is called an F/2F format. This means that the binary data is encoded with one logic level encoded at twice the frequency of the other. When the card is swiped, the clock and data is read from the card by looking at the difference in the two frequencies on the card. When there is a sudden increase or decrease in speed, it is possible to incorrectly interpret one of these signals as the other. This is what makes all magnetic stripe readers susceptible to failure due to sudden speed changes.

Design of the Hypercom Solution

Hypercom's FPE32 application is designed to react to a request for card data by:

- Activating the MSR(s)
- Collecting track data
- Ensuring valid Track 1 data or Track 2 data is collected
- Providing valid track data to the ECR.

IMPORTANT NOTE: Payment transactions can be completed using either Track 1 or Track 2 data in the Authorization and Settlement request. If the Optimum L4100 terminal collects valid cardholder data for either track, it does not report an error and sends the available data to the ECR. It is only when both Track 1 and Track 2 data are invalid that the Optimum L4100 will report a Card Swipe Error and prompt the consumer for re-entry.

Most vendors quote acceptable card swipe speed to be 5-55 inches per second. The Hypercom Optimum L4100 is designed to handle card swipe speeds of 3-100 inches per second (7-250 centimeters per second).

Investigation and Results

Hypercom noticed at card swipe speeds below nominal operating rates (less than 3 inches/second) Track 2 data was not being transmitted to the Host, however Track 1 data was still present, valid and being forwarded. In fact, Hypercom Engineers halted the card completely halfway through the swipe attempt, and then resumed the card swipe within one second of stoppage.

The result: ***Even with the card completely halted for up to one second, Track 1 data was transmitted accurately and successfully.***

At first, this seemed contradictory to the expected results, due to our past experience indicating higher reliability of Track 2 data collection on card swipe for the reasons stated above. This intriguing result inspired the Hypercom Engineers to further explore this situation. *Exactly why was the Hypercom Magnetic Card Reader performing so reliably outside of the normal operation mode?*

What they discovered was that the decoder used within the Optimum L4100 is incredibly adaptive to sudden and dramatic card speed variations, as well as having a very large speed-read range. As the tracks on the card are encoded at different densities, those with denser track data such as Track 1 and 3 can be more reliable



due to the compressed spacing, and allows the reader to better detect speed variation, from incorrect interpretation of a data change, without error.

Summary

The Optimum L4100 has an extraordinary ability to deliver accurate reads of card data well outside of the nominal swipe speed range. Tests indicate that the Optimum L4100 terminal is actually performing better than specified. This means that for cards swiped at rates significantly below the optimal rate, the Hypercom device can still decode the information on a first-swipe basis, reducing overall transaction time and customer frustration.

In addition to this incredible performance we are seeing in the field, the Optimum L4100 MSR has been designed with the following capabilities to further ensure first-time card read success:

- **High noise immunity** – withstands noisy PC monitors, cell phones, switching power supplies, etc.
- **High performance decoding** – reads badly damaged cards; compensates for poor head mounting
- **AGC (Automatic Gain Control)** – reads cards from 30% - 200% of International Standards Organization (ISO) 7811 amplitude standard
- **Wide range of card swipe speeds** – from 3-100 inches per second (7-250 centimeters per second) for the standard 75-210 bits per inch (bpi) data density
- **Hi ESD immunity** – protection from ESD discharges directly to MSR head up to 16KV
- **Hi RF immunity** – immunity from Radio Frequency Interference that can create false or bad reads.

The Automatic Gain Control feature allows the decoder to automatically compensate for reasonable noise levels and eliminate the "plastic bag" solution often used in an attempt to have the reader successfully read noisy cards. This problem is solved by automatically adjusting the read threshold level and ignoring levels of noise on a card MSR that a fixed level decoder will detect and incorrectly read.

The MSR reader features circuitry that filters most ambient noise and prevents the card reader from picking up nearby radio frequency interference that may cause error messages.

The Hypercom L4100 Magnet Stripe Card Reader is operating reliably, and better than industry standard, thus providing significantly better performance than competitive solutions.



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