PT40 Postal Tag User Manual

Version 3 – May 2012

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1   INTRODUCTION

1.1   Purpose

The purpose of this document is to describe the functionality and operation of the PT40 tag intended for use in a RFID system custom designed for International Post Corporation. The tag features reflect the application requirements. You can find more details into "PT40 Functional Specifications".

1.2   Definitions

Valid LF Field – A 125 kHz carrier signal modulated OOK with a signal carrying the exciting device identification number (ExID).
Excitation Mode – tag transmits its ID together with the exciter ID when it is woken up by a valid LF field.
Transmission – When is excited by a valid LF field, the tag transmits its ID over a 433.92 MHz FSK modulated carrier.

2   PT40 OPERATION DESCRIPTION

Postag PT40 is a transponder (RF Tag) that receives an excitation signal and responds by transmitting back a message. It is custom designed for low cost and reliability in the postal environment. It is a direct replacement of previous models PT21, PT23, and PT30 tags and can be used with any of the Lyngsoe RFID systems – S96, S21 S23, and S30.
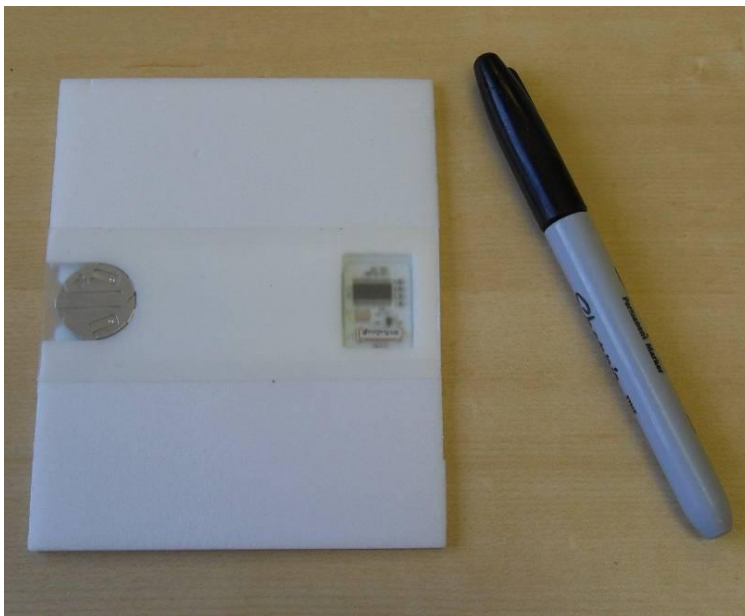
Figure 1 – PT40 Front side

Figure 2 – PT40 Back side

Postag PT40 provides the following main functions:
- Identifies a valid 125kHz excitation field and reads its excitation identifier (ExId);
- Following a valid excitation, it transmits on 433.92MHz several identical messages that include (among others) the tag user data, the ExId and a battery flag.
- Its user data and operating parameters are programmed wirelessly using a special programming device

2.1   Modes of operation

Postag PT40 has several main modes of operation: sleep, LF excitation recognition, UHF transmission and programming. The sleep mode is the normal mode of operation.

In the sleep mode, only the LF receiver is powered up and the total current consumption is less than 5uA. When a LF signal is detected by the LF receiver, it wakes-up the microcontroller to check if this signal has a valid modulation pattern. The LF field validation is done by the microcontroller using an RC internal 90 kHz clock at a low current consumption. If a valid excitation field is recognized, then the microcontroller wakes-up its UHF Transmitter and transmits on the UHF the pre-programmed messages. When PT40 recognizes a valid S21 / S23 excitation it transmits on UHF messages using S21 format. The PT40 operation and the message content can be programmed using dedicated devices.

The tag transmits a number of messages each time it enters a valid S21 or S23 fields. First transmission is delayed a few ms depending of the parameter WID that programmed randomly for each tag within the 10 -30 range during the manufacturing process. Subsequent transmissions are each randomly delayed compared with the preceding one based on a calculation that involves several random numbers generated internally function of another parameter WSD. This WSD parameter is also programmed randomly for each tag within the 10 -30 range during the manufacturing process. Repeating the same message a number of times ensures that, even if multiple tags are excited in the same time, many messages will not collide and at least one from each tag will be successfully received.

2.2   Valid Excitation Fields
For a field to be valid, it has to have a special pattern called exciter ID. If fields with different exciter ID overlap and a tag moves from one to another it will transmit WEP number of messages each time it "sees" a new exciter ID.

2.3   Commands and Parameters
The commands and parameters accepted by Postag PT40 are the same as for the Postag PT21 / PT23 and are listed in the RFID System S21 – Reference Guide, document 950061 rev. 1.

The most used programmable parameters for PT40 are WIP, WRC and WUD. Examples of default parameters' values that will fit most applications are:

WUD   =   "xxxxx" - use this command to program 5 characters of user data
WIP, WRC=   their sum represents the number of identical messages to transmit following an excitation. WIP parameter range is 1 to 20, WRC parameter range is 0 to 10 - default values are 10.
WID   =   randomly assigned initial delay after an excitation before the first UHF transmission, multiples of 4 ms, range 1-200, default 1. This ensures a randomization of the first transmissions following an (almost) simultaneously excitation of multiple tags.
WSD   =   inter-message random delay, range 7 – 15, default 10 (used for calculating the random interval between two successive UHF transmissions)

2.4   PT40 vs. PT21
The main functional differences between tags model PT40 and PT21 are related to the ExId range of identifiers, the black-out time, and the direction of maximum LF sensitivity.

2.4.1   ExId range

Postags PT21 recognize and report received ExId with S21 format in the range 0 to 31.
PT40 recognize and report received ExId with S21 format in the range 0 to 31, and with S23 format in the range 0 to 127.

2.4.2   Black-out

Black-out is the minimum time interval between two consecutive excitations which the tag can recognize. Postag PT21 has a black-out time 10.0 s. For PT40 this blackout time was reduced to about 2-3 s. In situations where we want to re-register a tag that leaves and re-enters a field with the same exciter ID, the tag has to be out of the field for more than the black out time duration. This happens for example when you try to excite a tag multiple times using the same exciter, like a Universal Programmer UP23 box. The tag will not transmit if it enters an LF field but the excitation pattern cannot be recognized (i.e. overlapping fields or interference).

3   REGULATORY COMPLIANCE

This device complies with part 15 of the FCC Rules. Operation 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.

This equipment has been tested and found to comply with the limits for Class B digital devices, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

3.1.1   Maximum Transmission Time

To comply with 15.231(a) of FCC regulations, the maximum transmission time of PT40 in Excitation mode must not exceed 5 seconds.
To minimize collisions in an application, PT40 tags are programmed with random values for the WSD parameter, which ensures that inter-message durations are randomized differently for individual tags. To ensure sufficient transmission redundancy in an application a certain optimum number of transmitted messages is selected and programmed into the WIP+WRC parameters. The sum of both parameters represents the number of messages transmitted in a burst and this affects the overall transmission duration.

In our typical application WIP + WRC = 20 and WSD = 7 and the resulting average transmission time is around 2s. If we set maximum values for these parameters WIP + WRC = 30 and WSD = 30 the resulting transmission time is 4.3s so PT40 still complies with the FCC requirements for maximum transmission time.

3.1.2   Maximum Duty Cycle

To comply with 15.231(a) of FCC regulations from average transmitted power point of view, the maximum transmission Duty Cycle for PT40 must not exceed 24% in any 100ms time window.

The maximum value of duty cycle in PT40 is achieved when 100ms window falls on the Excitation transmission bursts. The table below shows the best estimate of the duty cycle in 100ms for different combinations of WEP = WIP+WRC and WSD. As we

can see as long as WEP = WIP+WRC > 3 and WSD ≥ 7 the duty cycle in any 100ms window varies between 8% and 16% so there is margin compared with the maximum value of 24%.

Max Duty Cycle: 20 %   **Annex_3**

WSD

WEP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
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4	16	16	16	16	16	16	16	16	16	16	12	12	12	12	12	12	12	12	12	12	12	12	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
5	20	20	20	20	20	20	16	16	16	16	12	12	12	12	12	12	12	12	12	12	12	12	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
6	24	24	24	24	20	20	16	16	16	16	12	12	12	12	12	12	12	12	12	12	12	12	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
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39	33	29	29	24	20	20	16	16	16	16	12	12	12	12	12	12	12	12	12	12	12	12	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
40	33	29	29	24	20	20	16	16	16	16	12	12	12	12	12	12	12	12	12	12	12	12	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8

Maximum possible Duty Cycle in any 100ms time window during a transmission of one packet of MsgNo messages (set by WBP, WEP, WEB tag parameters).
This graph also depends on values of CC and EN parameters set in TagParms form.