AMSAT Software group UK
Phase 3B telemetry block formats

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Issue:

Draft A	14 January 1983
Draft B	18 January 1983
Draft C	25 January 1983
Draft D	26 April 1983, SV, SSV, TR-P, BETA added to Q-block. LIU removed from Q-block.

Status:
Specification document. (See below.)

History:
The original P3 TLM format specification appears to have been mislaid.

Sources of information:
Meeting K.Meinzer and s/w group August '82.
Telephone conversations with K.Meinzer.
Telephone conversations with J.King

Circulation:

K.Meinzer	AMSAT-DL
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Who else?	

Draft FOR COMMENT

QUESTIONS:

Are IPS response blocks correct?

What further high level info is desirable?

What about **formal layouts for M-blocks**?

NOTES:

D-block spec is not included in this draft. It will be included in the next draft. D-blocks will only be implemented if development time permits.

Space/. feature withdrawn.

Number translation into character representation, as in Y block, TB0, TB1, TB2 slows things down considerably in the craft and **is much better done on the ground.** As a result of this, it is intended that **Y-blocks will be sent infrequently, if at all.**

N.B. This is still a draft. It will be issued when I have seen some genuine P3B telemetry blocks!

1. Transmission conventions.

1.1 512 data bytes per block, treated as 8 lines of 64 bytes each.

1.1.1 The lines are numbered TB0 to TB7.

1.1.2 The leftmost byte on a line is numbered 0, followed by byte 1, to byte 63 on the right hand side.

1.1.3 The transmission order is that TB0 is transmitted first, followed by TB1 with TB7 sent last. For each line byte 0 is sent first followed by byte 1 with byte 63 sent last.

1.2 A 2 byte CRC is appended to the 512 data bytes, as defined by the AMSAT satellite data transmission conventions.

1.3 All characters use ASCII representation.

1.3.1 Normally bit 7 is set to 0.

1.3.2 Bit 7 is set to 1 to indicate highlighted character display. (Inverted foreground/background.)

1.4 Direct 16 bit values are transmitted with the least significant byte of the value in the lowest order byte of the transmitted line.

2. Block identification. According to the first 2 bytes of the block. (_ represents a space, coded as #20.)

2.1 **M block** first 2 bytes are **M_**

2.2 **Q block** first 2 bytes are **Q_**

2.3 **Y block** first 2 bytes are **Y_**

2.4 **K block** first 2 bytes are **K_**

2.5 **Not <letter>_** the block is an **IPS response block** to ground station input.

2.6 **Special telemetry.** Blocks identified as **F_**, **G_**, **H_**, **I_**, **J_**. The format of these blocks is to be advised. They will be used in connection with **motor firing.**

3. Line specification for K, Q, Y blocks.

(d = decimal digit)
(d..d = decimal number, positive only, **left justified** in field specified)
(h = hexadecimal digit)
(hhhh = 4 digit hexadecimal number including leading zeroes)
(<Id> = 2 byte identifier specified in 2 above.)
(<name> = satellite identification text.)
(nn = 2 digit decimal number including leading zeroes)

3.1 TB0

Byte posn. =	0 2	48	58
	<Id> <name>	**nn:nn:nn**	**ddddd**
		H M S	AMSAT day number
		UTC	1 January 1978 = 0

3.2 TB1

Byte posn. =	0	8	16
	#hhhh	**#hhhh**	**#hhhh**
	safety	transponder	command
	information	status	number
	word	(Syspage	
		byte #5E)	

neue Soft (Sept. 84)

BIT 0...4 Intern (Kommando-Info)
BIT 5...7 BCD-Zähler für Softtimer pro Orbit
18 QRO-Mode
BIT 9 Transponder Notbetrieb (QRM)
BIT 10 INTERN
BIT 11 Übertemp. beim Transponder oder Batterie
BIT 12 Sonnenwinkel > 50°
BIT 13...15 nicht benutzt

3.2.1 Safety information word.
Sometime after launch, the information in bits 8 to 11 will be withdrawn. (wegfallen)

Bit	Meaning
0	)
.	) as syspage byte #56
7	)
8	He pressure status (1 = low He pressure, after firing pyrovalve.)
9	Separation power (1 = separated)
10	Motor valve status (1 = open)
11	Fire keys status (1 = motor armed)
12	)
.	) not used
15	)

3.3 TB2

Byte posn. =	0	4	24
	dddd	**dddd**	**dddd**
	2MUX	2MUX	2MUX
	ch 0	ch 1	ch 6

3.4 TB3

3.4.1 Blank line.

3.4.2 Satellite orbital information. 10 current orbital reference parameters, as used by the AMSAT elliptical tracking algorithm, plus attitude information from the high level routines. The fields are direct 16 bit values, in byte pairs:

byte posn	parameter
0	PHI
2	PHF
4	RECTASR
6	PERIGAR
8	INCL
10	D#R
12	TWR
14	O#R
16	KO
18	KW
20	SV (spin vector in BAHN notation, see

22 P3 orbit and attitude software)
24
26 SSV (desired spin vector)
28
30
32 TR-P (Earth angle, see above)
34 BETA (sun angle, see above)

36 to 56 available for allocation

3.5 TB4-TB7

3.5.1 Compressed SYSPAGE.

3.5.1.1 TB4-TB5
Intermediate event syspage buffer. Up to 6 events stored, 128 bytes per event. Decode as 3.5.1.2 but word #7E is an event counter. The buffers are read out cyclically, one event at a time. The time recorded and the event counter identify the particular event.

3.5.1.2 TB6-TB7
SYSPAGE logical telemetry channels, laid out in order. Channel 0 in TB6, byte 0, Channel 1 in TB6 byte 1, channel #40 in TB7 byte 0 etc.
Decode according to phase 3B logical telemetry decoding document (not generally available) or phase 3B user's telemetry decoding document.
N.B. bytes are expressed directly, not as character values.

3.5.2 SYSPAGE logical telemetry channels 0-63 (analog channels). 16 channels/line, 4 bytes/channel. Channel value expressed as dddd.
Channel 0 in TB4 bytes 0-3, channel 1 in TB4 bytes 4-7 etc.

4. Block specification.

4.1 K Block invokes paragraphs:
3.1 (2.4)
To carry orbital parameter information.
Formal specification required

4.2 M block invokes paragraph:
2.1
TB0 byte 2 to TB7 byte 63 carry a message from one command station to another.
There is a possible **broadcast** use.
Formal specification desirable for broadcast use

4.3 Q block (compressed data format) invokes paragraphs:
3.1 (2.2)
3.2
3.3
3.4.2
3.5.1
N.B. 3.4.2 may not be implemented in time for launch,

in which case 3.4.1 will apply. 3.4.2 will be implemented later.

4.4 Y block (plain text analog telemetry channels, obsolete) invokes paragraphs:
3.1 (2.3)
3.2
3.3
3.4.1
3.5.2

4.5 IPS response block invokes paragraph:
2.5

4.5.1 Checksum OK block received, no language error.
TB0 and TB1 contain a stack display. (Up to 16 items displayed.)
TB2-TB6 are all spaces (blank lines).
TB7 contains an identification message. TB7 bytes 62 and 63 are set to **spaces.**

4.5.2 Checksum OK block received, language error.
The block containing the error is echoed.
TB7 bytes 62 and 63 are set to **spaces.**

4.5.2.1 Unrecognised word. Word in error is echoed highlighted.

4.5.2.2 Other errors. Word in error is highlighted.
TB7 contains an error message.

4.5.3 Checksum failed block received.
TB0-TB7 echo the received block lines 0 to 7.
TB7 bytes 62 and 63 set to **KE.**

End of document

DB205

AMSAT Software group UK
Phase 3B logical telemetry channels
Syspage information

General user's document

Author:
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Issue:
Issue 1 2nd June 1983. Derived from P3B syspage information, issue 1.

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D. Mellozzi P3 User's n

Status:
Derived document

Reference:
Phase 3B telemetry block formats.

Assistance:
Jan King, Karl Meinzer, John Rabson.

6 copi

1. Introduction. The 128 lower bytes of the syspage form 128 logical channels for telemetry purposes. This document comprehensively records the decoding of this information channel by channel.

1.1 Logic convention. **Positive logic** is used. When a bit is set to **1** the associated condition is **true**.

1.2 Channel numbers use hexadecimal notation. Other numbers are decimal, unless preceded by a # to indicate hexadecimal.

2. Abbreviations.

2.1 Byte numerical information:

2.1.1 **C** - unsigned count (0 to +255)
2.1.2 **Cs** - signed count (-128 to +127, 2s complement)
2.1.3 **Cx** - signed count (+63 to -192, #3F= +63, #FF= -1, #80= -128, #7F= -129, #40= -192, modified 2s complement)

2.2 **En** - * 10^n

2.3 **I** - current. Current channels are linear, and similar channels are grouped according to their nominal FSD. All channels of a particular nominal FSD have identical calibration:
2.2.1 1A. I = (C - 15) * 4.128 mA
2.2.2 2.5A. I = (C - 15) * 10.32 mA
2.2.3 5A I = (C - 15) * 20.64 mA

2.4 **LX** - mode L transponder.

2.5 **LIU** - Liquid ignition unit. Motor spark plug.

2.6 **Pn** - solar panel n.

2.7 **S** - separation bus. 14volt bus that supplies torquer and LIU.

2.8 **SEU** - sensor electronics unit.

2.9 **ST** - Transponder separation bus.

2.10 **T** - temperature. All channels are decoded identically. The decoding relationship is:
T = (C - 127) / 1.82 Celsius.

2.11 **TBA** - To be advised

2.12 **TC** - thermocouple.

2.13 **U** - Voltage

2.14 **Uad** - A/D input voltage

2.15 **UX** - mode U (B) transponder

2.16 **^n** - raised to the nth power

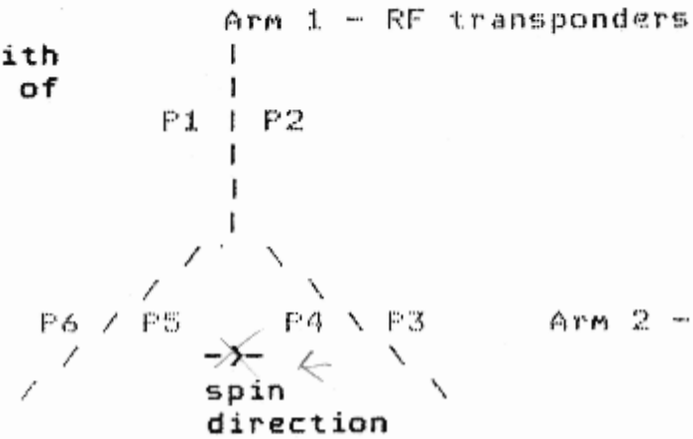
3. A/D conversion. All measured analogue quantities are transformed to a voltage in the nominal range 0V to 2V. Subsequent A/D conversion is linear, with no offset.

3.1 A/D fundamental calibration.
At C = #FF, Uad = 1.951 V. (Uad = 1V, C = 131.2)

3.2 False zero.
Voltage and current channels calibrated by an equation of the form (C-N)*K do not take a negative value. **All apparent negative values** should be treated as **zero.**

4. Physical configuration.

Satellite as seen with gain Aerials on top of the paper



The side of the spacecraft that the high gain 24cm antenna is mounted on is known as the **top** of the craft.
The **bottom** of the craft has the motor exhaust.
The **z axis** passes **bottom to top** through the junction of the 3 arms, and is the craft's intended spin axis. The top is the +ve direction.
The motor strut thermocouple is fixed 25mm from the main structure end of one of the four motor support struts.

5. Channel identification. alle Nachträge beziehen sich auf den Y-Block bei Z-Bl bei KTH

siehe AMSAT-Journal 23/24 84

Byte	Channel	Calibration	Remarks
00	Uin-BCR	U=C*150mV	correct at 500mA. Reads 100mV low at 2A.
01	U-PWRout-LX	Average power=(253-C)^2/2000Watts	rectified envelope voltage. Starts from fixed value and counts down.
02	T-Rx-UX		
03	----- Temp. des Nutationsdämpfers		T
04	U-main battery	U=(C-10)*75mV	**Uout-BCR**
05	-----		
06	T-TX-UX		
07	T-14V-ST	5A	
08	U-10Vcontinuous	U=(C-12)*50mV	Normally C=212
09	U-pressure1	pressure=(C-34)*44.44bar	(He-hi) Typically 420bar. Helium tank.

Byte	Channel	Calibration	Remarks
0A	T-IHU		
0B	I-14V-S	1A	strom für Lage regelung und Relais
0C	BCR-Oscill1	)^25=OK >=10 norm. in Betrieb	BCR status. No count = not working. Typically C=90.
0D	U-pressure2	pressure=(C-37)*0.8bar	(He-low) Typically 15bar. Helium regulator output.
0E	T-BCR		
0F	I-10Vcontinuous	1A	I10V-C nominal consumption 200mA.
10	BCR-Oscill2	As channel 0C	
11	-----		(ex pressure3 He-lo)
12	T-SEU		
13	Ibatcharge	2.5A	Positive current to battery
14	U-topsensor	C=65 indicates 1 solar constant into sensor C=~10 background	Sun sensor. Sun declared present when C) 20. Only 1 of the top or bottom sensors will indicate sun at once, in usual operation neither. (s/c z axis normal to sun direction)
15	U-motorvalveindicator	C=44 - closed C=50 - open	+ve temperature coefficient, amount unknown. Perhaps +/- 2 count variation.
16	T-case 1 of main battery		
17	I-BCRout	5A	14V line to battery and other consumers, including input current to 10V regulator.
18	U-bottomsensor	As channel 14	
19	Motor strut TC	T=(C-12)*4Celsius over channel 2E	Expected to be 30Celsius over.
1A	T-case 2 of main battery		
1B	I-BCRin	2.5A	28V line from arrays
1C	Spin rate	C)=139, Spin rate=(508/(C-116))-2rpm C(139, Spin rate=((139-C)*0.8)+20rpm	Sensor angular position oscillator. Lock indication ch 47.
1D	Rx-LX-agc	C)100, Gain reduction=(C-100)^2/189dB C(=100, Gain reduction=0dB	
1E	T-auxiliary battery		
1F	I-P6	1A	
20	U-PWRout-UX	Average power=(200-C)^2/2000Watts	As channel 01.
21	T-He tank		
22	T-P1		
23	I-P5	1A	
24	Rx-UX-agc	Gain reduction=(C-83)^2*E-3dB	Idles at C=83
25	T-Tx-LX		
26	T-P3		
27	I-P4	1A	
28	-----		
29	T-Rx-LX		
2A	T-P5		
2B	I-P3	1A	
2C	U-14V-ST	U=(C-10)*61.5mV	

Byte	Channel	Calibration	Remarks
2D	T-wall-arm3		Inner vertical arm.
2E	T-top		Arm 1, top surface.
2F	1-P2	1A	
30	U-9V-UX	U=(C-10)*50mV	Internal 9 volt bus from Xponder. Nominal C=197.
31	T-wall-arm2		
32	T-bottom		Arm 1.
33	1-P1	1A	
34	-----		
35	T-wall-arm1		
36	T-N204		
37	----T- UDMH		
38	U-auxiliary battery	U=(C-10)*75mV	
39	T-central support cylinder		Arm 1.
3A	T-sensors		Earth sensor.
3B	-----		
3C	U-9V-LX	U=(C-10)*44mV	As channel 30. Nominal C=222.
3D	T-UDMH		
3E	T-nutation damper		Arm 3.
3F	-----		

2MUX channels are **control** channels. Exceptionally, channel 3 records the state of the LIU burn time remaining counter. For the relays of channel 1 to operate, magnet power must be activated.

40	Earth sensor sensitivity threshold			
		bit	significance	
		0	20mV	
		1	37mV	Hysteresis 200mV
		2	75mV	Threshold 600mv typical ??
		3	150mV	Absolute calib. after launch.
		4	300mV	
		5	600mV	
		6	1.2V	
		7	2.4V	2MUX channel 0
41	Antenna	bit	significance	
		0	Hi-gain 2m ON	
		1	Hi-gain 70cm to UX, lo-gain 70cm to LX	
		2	Hi-gain 24cm ON	
		3	L Xponder ON	2MUX channel 1
42	Motor-power-status			
		C=#AA - ON, otherwise OFF		2MUX channel 2
43	~~CIU counter~~	~~Burn time remaining=C*2.5s~~		
			Normally 0.	2MUX channel 3
44	BCR-Uin	U=29.1+(Cs*100)mV		
	BCR-SIN	[redacted]	Array voltage offset. If measured BCR i/p voltage > commanded i/p voltage implies positive power budget.	
				2MUX channel 4
45	BCR-Uout	U=14.98+(Cx*20)mV		
	BCR-SO		Battery knee voltage offset.	
				2MUX channel 5

Byte	Channel	Calibration	Remarks
46	ECR-relays	bit significance 0 ECR2 ON 1 auxiliary battery connected via parallel diode and R. R for charging, discharge via diode. 2 auxiliary battery connected, main disconnected.	2MUX channel 6
47	SS1	C=#FF or C=#00 - PLL locked	Sensor angular position oscillator.
48	SS2	Time offset from SS1	Sun sensors. Require arctan to provide elevation of sun over S/C equator.
49	MarkSS1/FlagSS2		Sun sensors.
4A	Instantaneous spin-count		
4B	Sensor control	bit significance 0)mux control for sensor elec. module 1) 00 - Sun data 01 - spin ref./spin counter 10 - ES upper beam 11 - ES lower beam 2 Earth sensor positive edge select. (Strobes value of spin count at transition.) 3 motor instrumentation ON. (pressure sensors, motor valve indication.) 4 300mV) 5 600mV)sun sensor sensitivity. 6 1.2V)max threshold =~1 solar 7 2.4V)constant.	
4C	----		
4D	)	4 bytes containing Z and Orbit # relating to earth sensor's last update. (Used during early orbits to capture perigee data, with ~60 degree lockout range.) **Further information follows.**	
4E	)		
4F	)		
50	)		
51	Lockoutrange	Within +/- C counts from s/s pip, earth sensor handler ignores data. (Spin count 1 circle = 256.)	
52	ES1	Strobed spin count at edge selected	Earth sensor lower beam
53	Update flag1	Indicates update, reset by high level	Earth sensor lower beam
54	ES2	Strobed spin count at edge selected	Earth sensor upper beam
55	Update flag2	As 53	Earth sensor upper beam

Byte	Channel	Calibration	Remarks
56	STATUS	bit	significance
		0	
		1	LIU power ON
		2	
		3	**Arm plug present**
		4	
		5	}
		6	}memory soft error counter
		7	}
57	----		
58	----		
59	----		
5A	----		
5B	N	no of 20ms per dot	morse speed.
5C	n	running count of units for morse.	
5D	GB-STATUS	bit	significance
		0	GB CW/RTTY driver running
		1-7 = 0 when sending morse.	
5E	Transponder control		
		bit	significance
		0	GB OFF keying bit
		1	GB FSK MARK keying bit. mark = +170Hz shift.
		2	DPSK OFF Usually set to 0 except when using convolutionally encoded transmission. (PSK ON)
		3	EB ON
		4	}
		5	}PSK source for GB ⇒ EB: don't care 00 - no PSK 01 - ranging 10 - EB source 11 - illegal
		6	Low power transponder (passband -3dB)
		7	passband off, EB and GB + 3dB
5F	----		
60	MODUS-magnet control		
		bit	significance
		0	magnet system ON
		1	undespun magnet
61	M-SOLL	magnet vector desired angle to the despun sun (clockwise as seen from top, 1 circle = 256)	
62	M-out	bit	significance
		0	polarity arm1
		1	polarity arm2
		2	polarity arm3
		3	magnet power ON OUTPUT port 3
63	0-FRAC-lo	Fractional Zincrement in 20ms.	
64	0-FRAC-hi	Counts down to 0 from preset value. 255th Z has different value of 0-FRAC. ~ 7000 counts / Z.	
65	0/256	Z from perigee	
66	0#-lo	Orbit number	
67	0#-hi		

Byte	Channel	Calibration	Remarks
68	UHR	10ms	UTC
69		s	
6A		min	
6B		hour	
6C		day	1st January 1978 = 0.
6D		256day	
6E	SU0		IPS stopwatches 0 to 3.
6F			
70			
71			
72	SU1		
73			
74			
75			
76	SU2		
77			
78			
79			
7A	SU3		
7B			
7C			
7D			
7E	unused	(lo)	Used as event ID word in
7F	unused		intermediate buffer.

End of document