STEREO
IMPACT

IMPACT/SWAVES Interface Control Document

IMPACT-SWAVES-ICD_B.doc

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A	2002-Sep-19	Preliminary Draft	-
B	2008-Apr-4	S/WAVES calibrations and units	
C	2008-May-15	Additional S/WAVES values	

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Table of Contents

1. Overview

1.1. *Introduction*

IMPACT and S/WAVES are instruments on the STEREO spacecraft. These instruments need to be able to exchange data on board for the purposes of coordinating data collection. Both instruments have the ability to collect short segments of high time resolution data. The communication channel allows the systems to improve the chance that the data segments collected overlap.

1.2. *Document Conventions*

In this document, TBD (To Be Determined) means that no data currently exists. A value followed by TBR (To Be Resolved) means that this value is preliminary. In either case, the value is typically followed by a code such as UCB indicating who is responsible for providing the data, and a unique reference number.

1.3. *Applicable Documents*

The following documents are closely interrelated with this specification. All documents can be found on the Berkeley STEREO/IMPACT FTP site unless otherwise indicated:

http://sprg.ssl.berkeley.edu/impact/dwc/

1. IMPACT_ICD_init_rev (IMPACT/Spacecraft ICD, on the APL web page)
2. SWAVES_ICD_init_rel (SWAVES ICD, on APL web page)

2. Communication Channel

IMPACT and S/WAVES are connected to the spacecraft 1553 bus as Remote Terminals (RT). This bus is used to forward commands to the instruments and collect telemetry from the instruments, as described in reference 1 and 2, under control of a Bus Controller (BC) in the spacecraft electronics. In addition this interface is used to allow S/WAVES and IMPACT to communicate using RT-to-RT transfer mode. Once a second, the BC sets up an RT to RT transfer in each direction (IMPACT to S/WAVES and S/WAVES to IMPACT). These transfers are to/from unique sub-addresses in the IMPACT and S/WAVES RTs. The details of this transfer are also described in Reference 1 and 2. This scheme allows IMPACT to send S/WAVES up to 64 bytes of data once a second, and vice versa.

3. S/WAVES to IMPACT Data

3.1. *S/WAVES Burst System*

S/WAVES collects a number of short Time Domain System (TDS) bursts, which it prioritizes based on a quality criteria computed from the burst data, and sends in priority order using a part of the normal S/WAVES telemetry bandwidth. This implies that data may sit in the burst memory indefinitely. The plan is for S/WAVES to upgrade the priority/quality of bursts that coincide with IMPACT bursts.

S/WAVES will provide information to IMPACT to be used as part of IMPACT's burst criteria. This shall include total power in the plasma frequency band, plus two HFR frequency bands. In addition, S/WAVES will provide the rate of interesting TDS events collected in the last 60 seconds. In addition to all that, S/WAVES will provide a simple measurement of DC antenna potential and its change as a function of time.

3.2. *S/WAVES Data Format*

Word 0:	TDS quality in the last 60 seconds
Word 1:	Power in the Plasma frequency band
Word 2:	Power in the HFR1 frequency band
Word 3:	Power in the HFR2 frequency band
Word 4:	Ey DC voltage (mV)
Word 5:	Change in Ey voltage (mV/s)
Word 6:	Change in Ey voltage (mV/m)
Word 7-30	Spare
Word 31:	Ascending counter

The values provided in the S/WAVES to IMPACT message are computed each second. Each second should bring all new values – even if they sometimes seem to be the same.

The TDS quality value (in word 0) is a simple numeric representation of the number of new TDS snapshots acquired in the past 60 seconds with a quality in the top quartile of existing TDS events. This number is positive and ranges from 0 to about 10. Bigger is

better. Values like 0, 1 and 2 are dull. Values like 7, 8 and 9 are apt to be interesting. Burst "quality" is a determined by an internal S/WAVES algorithm which is intended to provide "interesting" bursts to the ground. The particular algorithm may change. The value provided here is intended to reflect the number of new events with a high likelihood of getting to the ground.

The plasma frequency power (in word 1) is the average power observed in the frequency band from 10kHz to 160kHz. The samples are obtained from S/WAVES LFR bands B and C, channel 1 (usually Ex-Ey). The antenna configuration can change (but seldom does). The value is always positive. The units are 24*dBs (a value of 240 is 10dBs above background/minimum). Bigger numbers mean more power. In general, changes in this value and especially increases will be interesting for burst triggering. An increase of 10dBs (240 counts) is a lot! The background value moves around a little but hovers around 10 dBs (e.g. 292 counts).

The HFR1 frequency power (in word 2) is the average power observed in the HFR1 frequency band which is normally from 125kHz to 2MHz. The samples are obtained from S/WAVES HFR1, channel 1, DF sweep 1 (usually Ex). The antenna configuration and the frequency coverage can change (but seldom do). The value is always positive. The units are 24*dBs (a value of 240 is 10dBs above background/minimum). Bigger numbers mean more power. In general, changes in this value and especially increases will be interesting for burst triggering. An increase of 10dBs (240 counts) is a lot! The background value moves around a little but hovers around 10 dBs (e.g. 220 counts).

The HFR2 frequency power (in word 3) is the average power observed in the HFR2 frequency band which is normally from 2MHz to 16MHz. The samples are obtained from S/WAVES HFR2, channel 1 (usually Ex-Ey). The antenna configuration and the frequency coverage can change (but seldom do). The value is always positive. The units are 24*dBs (a value of 240 is 10dBs above background/minimum). Bigger numbers mean more power. In general, changes in this value and especially increases will be interesting for burst triggering. An increase of 10dBs (240 counts) is a lot! The background value moves around a little but hovers around 20 dBs (e.g. 426 counts).

The Antenna Potential Monitor (APM) values (in words 4, 5 and 6) are DC coupled samples obtained through a large resistance to the Ey antenna and another large resistance to ground. The Ey antenna is most directly coupled to the plasma (and distant from the spacecraft) and is probably the best DC measurement we make.

The Antenna Potential Monitor (APM) value (in word 4) is a simple DC sample instantaneously measured once each second. The 16-bit value is a 2's complement signed number. The units are roughly mV. A value of 1000 corresponds to about plus one Volt. Exact calibrations are far from perfect. Typical values are slightly positive and values of about +1,000mV are common. Large changes can be about .5V (500 counts) or more and can be abrupt over the course of a minute or can slowly ramp up over the course of a few hours.

The derivative of the Antenna Potential Monitor (APM) value (in word 5) is a better measure of interesting DC activity. It is the arithmetic change in the value from the previous second's observation. The 16-bit value is a 2's complement signed number. The units are roughly mV/second.

The derivative of the Antenna Potential Monitor (APM) value (in word 6) is likely an even better measure of interesting DC activity. It is the arithmetic change in the value from the previous minute's observation. The 16-bit value is a 2's complement signed number. The units are roughly mV/minute.

The ascending counter (in word 31) is a simple counter. It is an unsigned 16-bit integer. It probably starts at 1 and rolls over to zero at 64k seconds and so on.

4. IMPACT To S/WAVES Data

4.1. *The IMPACT Burst System*

The IMPACT Burst system is designed to provide high time resolution data from MAG, SWEA and STE instruments for a short time interval (about 10 minutes). The data is then played back as part of the normal IMPACT science telemetry over a period of several hours. The time interval selected is based on a burst criteria computed from the instrument data. The system is designed to provide the data segment with the best burst criteria. IMPACT has 3 burst segments: the one currently being telemetered (T), the best one seen (highest burst criteria) since T started to transmit (B), and the current collection buffer (C). C is continuously cycling in data from the instruments until its criteria value is better than B (at that point C and B swap). T is guaranteed to get to the ground (unless there is a telemetry dropout). B may get to the ground unless something better comes along.

The burst criterion is a programmable weighted average of a number of sub-criteria computed from the IMPACT instrument data and data provided from S/WAVES. The criterion is a 16-bit unsigned number where larger numbers indicate a more desirable burst.

Also provided is the time (in spacecraft UTC) that the burst collection covers (start and end). These times are 32-bit seconds since epoch, using the same format that the time code is provided by the spacecraft (as described in reference 1 and 2), minus the sub-seconds. Times are sent Most Significant Word first.

4.2. *IMPACT Data Format*

The following data is sent:

Word 0,1	T-StartTime	Start time of IMPACT Burst T buffer collection
Word 2,3	T-EndTime	End time of IMPACT Burst T buffer collection
Word 4	T-Criterion	Criterion for burst buffer T
Word 5,6	B-StartTime	Start time of IMPACT Burst B buffer collection
Word 7,8	B-EndTime	End time of IMPACT Burst B buffer collection

Word 9	B-Criterion	Criterion for burst buffer B
Word 10	C-Criterion	Current burst criterion
Word 11-31	Spare	

All data are re-computed every 2 seconds by the IMPACT burst system. The most recent values are sent over the 1553 interface once a second, so typically the same value will be sent twice.