IPG CUTTING HEAD FIELDBUS INTERFACE

This document provides information on the IPG Cutting Head Field Bus Interface. The interface currently provides support for cyclical messaging to the Cutting Head Base Station. Support for non-cyclical messaging may be provided in future software revisions.

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1. INPUT/RESPONSE PROCESS DESCRIPTION

The Input/Response process is the cyclical data provided from the Cutting Head Base Station to the client. The input data is comprised of 40 Bytes as shown below.

Byte	Tag	Variable	Type	Description	Detail
0	**Status**	WARN	BITSET	Sensor Warnings	Table 1-2
1		GENERAL	BITSET	General Status Bits	Table 1-3
2		ALARM	BITSET	Sensor Alarms	Table 1-4
3		CALIBRATE	BITSET	Calibration status	Table 1-5
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8-9		FOCUS	Unsigned 16	Current Focus Position x100	
10-11		PIERCE	Unsigned 16	Pierce PhotoDetector Reading x100	
12-13		WIN_PD	Unsigned 16	Window PhotoDetector Reading x100	
14-15		FOCUS_T	Signed 16	Focus Lens Temperature Reading x100	
16-17		COLL_T	Signed 16	Collimator Temperature Reading x100	
18-19		WIN_T	Signed 16	Window Temperature Reading x100	
20-21		QUARTZ_T	Signed 16	Quartz Block Temperature Reading x100	
22-23		PROC_GAS	Unsigned 16	Process Gas Pressure Reading x100	
24-25		WIN_SEAL	Unsigned 16	Window Seal Pressure Reading x100	
26-27		PIERCE_IR	Unsigned 16	Pierce IR PhotoDetector Reading x100	
28-29		NOZZLE_T	Signed 16	Nozzle Temperature Reading x100	
30-31	**RESERVED**	RESERVED	--	Reserved for future use	
32-33	**Config**	CONFIG	Unsigned 16	Selected Configuration Reading	Table 1-9
34		CONFIG_ID	U8	Configuration ID of above reading	
35-39	**RESERVED**	RESERVED	--	Reserved for future use	

TABLE 1-1 INPUT PROCESS MAPPING

STATUS BITS

The mapping of the base station status bits is provided in the following tables. Bits that are labeled as warning or status will set or clear continuously based on their required condition. Bits that are labeled as alarms are latched once the condition has been satisfied. A clear alarms command must be asserted in order to reset the bit. A value of "1" indicates that the required condition has been satisfied. A value of "0" indicates the condition has not been met.

	Bit	Signal	Description
Byte 0 - WARN	**0**	TIP_TOUCH	Height Sensor has detected a tip touch
	1	COLLISION	Height Sensor has detected that head is within collision range
	2	ABOVE_RANGE	Height Sensor has detected that head is above maximum calibrated height
	3	LOST_NOZZLE	Height Sensor cannot detect current height (typically due to lost nozzle)
	4	TEMPERATURE	A Temperature sensor has exceeded its programmed warning threshold
	5	PRESSURE	A Pressure sensor is out of range of its programmed warning thresholds
	6	WINDOW	The window PD signal is reading above its programmed warning threshold
	7	Reserved	Reserved for future use

TABLE 1-2 INPUT PROCESS STATUS BYTE 0 "WARNINGS"

	Bit	Signal	Description
Byte 1 -GENERAL	**0**	Reserved	Reserved for future use
	1	Reserved	Reserved for future use
	2	Reserved	Reserved for future use
	3	Reserved	Reserved for future use
	4	Reserved	Reserved for future use
	5	AT FOCUS	The focus position is at the commanded focus setting
	6	INTERLOCK	The interlock from the controller is closed
	7	READY	The controller is ready for cutting (interlock closed, no alarms detected)

TABLE 1-3 INPUT PROCESS STATUS BYTE 1 "GENERAL"

	Bit	Signal	Description
Byte 2 - ALARM	**0**	COLL_TRAY	Collimator Tray is out
	1	WIN_TRAY	Window Tray is out
	2	TEMPERATURE	A Temperature sensor exceeded its programmed alarm threshold
	3	PRESSURE	A Pressure sensor exceeded its programmed alarm threshold
	4	SENS_BOARD	The height sensor board cannot be detected
	5	WINDOW	The window PD signal read above its programmed alarm threshold
	6	MOTOR_ERROR	The Focusing motor detected an error
	7	Reserved	Reserved for future use

TABLE 1-4 INPUT PROCESS STATUS BYTE 2 "ALARMS"

	Bit	Signal	Description
Byte 3 - CALIBRATE	**0**	CAL_REQ	State of Calibration REQUEST signal
	1	CAL_STROBE	State of Calibration STROBE signal
	2	CAL_ACK	State of Calibration ACKNOWLEGE signal
	3	CAL_ERR	State of Calibration ERROR signal
	4	CALIBRATING	Controller is currently in calibration mode
	5	Reserved	Reserved for future use
	6	Reserved	Reserved for future use
	7	Reserved	Reserved for future use

TABLE 1-5 INPUT PROCESS STATUS BYTE 3 "CALIBRATION"

	Bit	Signal	Description
Byte 4 - EXP_WARN	**0**	COLL_TEMP	Collimator sensor has exceeded its programmed warning threshold
	1	FOCUS_TEMP	Focus Lens sensor has exceeded its programmed warning threshold
	2	WIN_TEMP	Window sensor has exceeded its programmed warning threshold
	3	QUARTZ_TEMP	Quartz block sensor has exceeded its programmed warning threshold
	4	PROC_GAS	Process Gas pressure is out of range of its programmed warning thresholds
	5	WIN_SEAL	Window Seal pressure is out of range of its programmed warning thresholds
	6	Reserved	Reserved for future use
	7	Reserved	Reserved for future use

TABLE 1-6 INPUT PROCESS STATUS BYTE 4 "EXPANDED WARNINGS"

	Bit	Signal	Description
Byte 5 -EXP_ALARM	**0**	COLL_TEMP	Collimator sensor exceeded its programmed alarm threshold
	1	FOCUS_TEMP	Focus Lens sensor exceeded its programmed alarm threshold
	2	WIN_TEMP	Window sensor exceeded its programmed alarm threshold
	3	QUARTZ_TEMP	Quartz block sensor exceeded its programmed alarm threshold
	4	PROC_GAS	Process Gas pressure is out of range of its programmed alarm thresholds
	5	WIN_SEAL	Window Seal pressure is out of range of its programmed alarm thresholds
	6	Reserved	Reserved for future use
	7	Reserved	Reserved for future use

TABLE 1-7 INPUT PROCESS STATUS BYTE 4 "EXPANDED ALARMS"

SENSOR READINGS

The sensor reading values are all provided in the input process as 16-bit signed integers. In the Base Station, all sensor readings are internally scaled in floats based on their respective units. To accommodate floating point precision, the controller will scale the sensor readings by 100 before sending them as integers to the client via FieldBus. The client can then divide the input data by the scale factor to receive the equivalent float.

Sensor	Input Type	Actual Type	Units	SCALE	Description
HEIGHT	Unsigned 16	Float	mm	100	Calibrated Height reading
FOCUS	Unsigned 16	Float	mm	100	Focus position reading
PIERCE	Unsigned 16	Float	%	100	Pierce photodetector reading
WIN_PD	Unsigned 16	Float	%	100	Window photodetector reading
FOCUS_T	Signed 16	Float	°C	100	Focus Lens temperature reading
COLL_T	Signed 16	Float	°C	100	Collimator temperature reading
WIN_T	Signed 16	Float	°C	100	Window temperature reading
QUARTZ_T	Signed 16	Float	°C	100	Quartz Block temperature reading
PROC_GAS	Unsigned 16	Float	PSI/BAR	100	Process Gas reading (PSI or BAR based on config)
WIN_SEAL	Unsigned 16	Float	PSI/BAR	100	Window Seal reading (PSI or BAR based on config)
PIERCE_IR	Unsigned 16	Float	%	100	Pierce IR photodetector reading
NOZZLE_T	Signed 16	Float	°C	100	Nozzle temperature reading

TABLE 1-8 INPUT PROCESS SENOR READING BYTES

CONFIGURATION

This value contains the reading of the configuration parameter requested by the CFG value of the Output/Receive data. The table below provides the list of configuration parameters that may be read back. To get the original reading from the controller, the client must divide the given value by the SCALE amount. The CONFIG_ID byte contains the ID of the current configuration read.

ID	Configuration	Input Type	Original Type	Units	SCALE
1	Collision Warning Threshold	Unsigned 16	Float	µm	100
2	Window Dirty Threshold(Warning)	Unsigned 16	Float	%	100
3	Collimator Temperature Threshold (Warning)	Unsigned 16	Float	°C	100
4	Focus Temperature Threshold (Warning)	Unsigned 16	Float	°C	100
5	Window Temperature Threshold (Warning)	Unsigned 16	Float	°C	100
6	Quartz Temperature Threshold (Warning)	Unsigned 16	Float	°C	100
7	Process Gas Pressure High Threshold (Warning)	Unsigned 16	Float	PSI/BAR	100
8	Window Seal Pressure High Threshold (Warning)	Unsigned 16	Float	PSI/BAR	100
9	Process Gas Pressure Low Threshold	Unsigned 16	Float	PSI/BAR	100
10	RESERVED	--	--	--	1
11	Window Dirty Threshold(Alarm)	Unsigned 16	Float	%	100
12	Collimator Temperature Threshold (Alarm)	Unsigned 16	Float	°C	100
13	Focus Temperature Threshold (Alarm)	Unsigned 16	Float	°C	100
14	Window Temperature Threshold (Alarm)	Unsigned 16	Float	°C	100
15	Quartz Temperature Threshold (Alarm)	Unsigned 16	Float	°C	100
16	Process Gas Pressure High Threshold (Alarm)	Unsigned 16	Float	PSI/BAR	100
17	Window Seal Pressure High Threshold (Alarm)	Unsigned 16	Float	PSI/BAR	100
18	Filter Bandwidth setting	Unsigned 16	Float	%	100
19	Filter Hold Time setting	Unsigned 16	Float	ms	100
20	Filter Spatter Velocity setting	Unsigned 16	Float	m/s	100
21	Window Dirty On Time setting	Unsigned 16	Float	ms	100
22	Window Dirty Off Time setting	Unsigned 16	Float	ms	100
23	Calibration Height Range	Unsigned 8	Unsigned 8	mm	1
24	Calibration Type	Unsigned 8	Unsigned 8	--	1
25	Calibration Timeout	Unsigned 16	Unsigned 16	ms	1
26	Compensation Time	Unsigned 16	Float	ms	100
27	Control Input Settings	BITSET	BITSET	Bits	1
28	Focus Setting Readback	Signed 16	Float	mm	100

TABLE 1-9 CONFIGURATION READING OPTIONS

2. OUTPUT/COMMAND PROCESS DESCRIPTION

The Output/Response process is the cyclical data provided from the client to the Cutting Head Base Station. The output data is comprised of 32 Bytes as shown below.

Byte	Tag	Variable	Type	Description	Detail
0	**Control**	SOURCE	BITSET	Set Control Input Source	Table 2-1
1		CONTROL	BITSET	Control Input Signals	Table 2-2
2-3		FOCUS	Signed 16	Focus Setting value x100	FOCUS
4-5		RESERVED	--	Reserved for future use	
6-7	**Threshold**	TSEL	Unsigned 16	Threshold parameter select	Table 2-3
8-9		THRSH	Unsigned 16	Value for selected threshold parameter x100	THRSH
10-11	**Filter**	FSEL	Unsigned 16	Filter parameter select	Table 2-4
12-13		FILTER	Unsigned 16	Value for selected filter parameter x 100	FILTER
14-17	**RESERVED**	RESERVED	--	Reserved for future use	
18-19	**Compensate**	COMP	Unsigned 16	Collision Warning compensation time	Comp
20	**Calibration**	CAL_RNG	Unsigned 8	Set calibration height range	Table 2-5
21		CAL_TYPE	Unsigned 8	Set calibration type	
22-23		CAL_TIME	Unsigned 16	Set calibration timeout	
24	**Configuration**	CONFIG	Unsigned 8	Configuration readback select	Table 2-6
25-31	**RESERVED**	RESERVED	--	Reserved for future use	

CONTROL

The mapping of the Control bits is provided in the following tables. For the SOURCE bits, a value of "1" configures the controller to look at TCP, FieldBus, or Webpage values for the respective control input. A value of "0" configures the controller to look at the external interface for the respective control input. For the CONTROL bits, a value of "1" asserts the respective control, and a value of "0" removes it. Some controls, such as "Clear Alarms" are rising edge triggered only.

	Bit	Signal	Description
Byte 0 - SOURCE	**0**	CONTROL	Set Control bits source to FieldBus/TCP
	1	FOCUS_SET	Set Focus Setting Source to FieldBus/TCP
	2	Reserved	Reserved for future use
	3	Reserved	Reserved for future use
	4	Reserved	Reserved for future use
	5	Reserved	Reserved for future use
	6	Reserved	Reserved for future use
	7	Reserved	Reserved for future use

TABLE 2-1 OUTPUT PROCESS BYTE 0 "SOURCE"

	Bit	Signal	Description
Byte 1 - CONTROL	**0**	CAL_REQ	Set the calibration REQUEST control
	1	CAL_STROBE	Set the calibration STROBE control
	2	Reserved	Reserved for future use
	3	FOCUS_LATCH	Set the focus position setting latch control
	4	CLEAR_ALARMS	Clear alarm latch on rising edge (transition of this bit from 0 to 1)
	5	Reserved	Reserved for future use
	6	Reserved	Reserved for future use
	7	Reserved	Reserved for future use

TABLE 2-2 OUTPUT PROCESS BYTE 1 "CONTROL"

FOCUS

The requested focus position, multiplied by 100. The controller will only acknowledge this position if the focus setting source is set to 1. The controller will divide the given input by 100 to obtain the floating point setting.

Data Type: 16-bit signed integer
Example: Required focus position = -5.3 mm → 5.3 x 100 =-530 → FOCUS = 0x FDEE (-530 in hex)

THRESHOLD

These bytes allow the client to configure the sensor warning thresholds. The TSEL variable is used to select desired parameter to change, and the THRSH variable contains the new value to set. The following table provides the mapping of the TSEL variable to the threshold parameters. Values marked "DO NOT SET" will cause the controller to ignore these bytes and keep the last known configurations. NOTE: Any values set via fieldbus are note preserved after a power cycle or controller reset.

Value/ ID	Threshold
0	DO NOT SET
1	Collision Warning
2	Window Dirty
3	Collimator Temperature
4	Focus Temperature
5	Window Temperature
6	Quartz Temperature
7	Process Gas High Pressure
8	Window Seal Low Pressure
9	Process Gas Low Pressure
10-65535	DO NOT SET

TABLE 2-3 OUTPUT PROCESS TSEL MAPPING

Set the new warning threshold of the requested sensor (multiplied by 100). The controller will divide the given input by 100 to obtain the floating point settings.

Data Type: 16-bit unsigned integer
Example: Required Collimator Temperature = 98.3°C → 98.3x100 = 9830 → TSEL=5, THR =0x2666 (9830 in hex)

FILTER

These bytes allow the client to configure the height filter parameters. The FSEL variable is used to select the desired parameter to change, and the FILTER variable contains the new value to set. The following table provides the mapping of the FSEL variable to the filter parameters. Values marked "DO NOT SET" will cause the controller to ignore these bytes and keep the last known configurations. NOTE: Any values set via fieldbus are note preserved after a power cycle or controller reset.

Value/ ID	Filter Parameter
0	DO NOT SET
1	Bandwidth
2	Hold Time
3	Spatter Velocity
4	Window Dirty On Time
5	Window Dirty Off Time
6-65535	DO NOT SET

TABLE 2-4 OUTPUT PROCESS FSEL MAPPING

Set the new value for the requested filter parameter (multiplied by 100). The controller will divide the given input by 100 to obtain the floating point settings.

Data Type: 16-bit unsigned integer
Example: Required Spatter Velocity = 25.5 m/s → 25.5x100 = 2550 → FSEL=3, THR =0x09F6 (2550 in hex)

COMPENSATE

Set the new value for the tip-touch and collision warning compensation time (multiplied by 100). The controller will divide the given input by 100 to obtain the floating point settings.

Data Type: 16-bit unsigned integer
Example: Required compensation time = 120.3 ms → 120.3x100 = 12030 → CMP = 0x2EFE

CALIBRATION

The Calibration configuration bytes are all provided to the controller as unsigned integers. The following table provides more detail on the functionality of each byte.

Configuration	Input Type	Units	Description
CAL_RNG	Unsigned 8	mm	Set the height scaling for calibration. This unit effects the scaling of the height data reading and thresholds.
CAL_TYPE	Unsigned 8	ID	Select the calibration type to be performed on next request
CAL_TIME	Unsigned 16	ms	Set the Calibration timeout value. This is the allowed time from acknowledge to another strobe that the controller will wait before declaring a calibration error.

Value/ ID	Calibration Type
0	DO NOT SET
1	1 Pt Calibration
2	2 Pt Calibration
3-15	Do Not Set
16	16 Pt Calibration
17-255	DO NOT SET

TABLE 2-5 OUTPUT PROCESS CALIBRATION BYTES MAPPING

CONFIGURATION

This byte selects which controller configuration parameter should be read back to the client in the response data. The following table provides the mapping of CFG value, to configuration parameter.

Value/ ID	Configuration Parameter
0	DO NOT SET
1	Collision Warning Threshold
2	Window Dirty Threshold(Warning)
3	Collimator Temperature Threshold (Warning)
4	Focus Temperature Threshold (Warning)
5	Window Temperature Threshold (Warning)
6	Quartz Temperature Threshold (Warning)
7	Process Gas Pressure High Threshold (Warning)
8	Window Seal Pressure High Threshold (Warning)
9	Process Gas Pressure Low Threshold
10	RESERVED
11	Window Dirty Threshold(Alarm)
12	Collimator Temperature Threshold (Alarm)
13	Focus Temperature Threshold (Alarm)
14	Window Temperature Threshold (Alarm)
15	Quartz Temperature Threshold (Alarm)
16	Process Gas Pressure High Threshold (Alarm)
17	Window Seal Pressure High Threshold (Alarm)
18	Filter Bandwidth setting
19	Filter Hold Time setting
20	Filter Spatter Velocity setting
21	Window Dirty On Time setting
22	Window Dirty Off Time setting
23	Calibration Height Range
24	Calibration Type
25	Calibration Timeout
26	Compensation Time
27	Control Input Settings
28	Focus Setting Readback
29-255	RESERVED

TABLE 2-6 CONFIGURATION SELECT BYTES MAPPING