ENRAF NONIUS
854 ATG Interface

APPLICATION NOTES

ENRAF NONIUS 854 ATG Interface

Contents

INTRODUCTION

The interface between BBI's Network 3000 3330/3335/3310 system (asynchronous ports only) and an ENRAF-NONIUS 854 Advanced Technology Gauge (ATG) is achieved via a Custom Module implemented in firmware for use exclusively with PC developed versions of 33XX series software.

This document assumes familiarity with the ENRAF-NONIUS 854 Advanced Technology Gauge, as well as the ENRAF-NONIUS 858 Communications Interface Unit, and their respective related terminology. For additional information on these products, the user is advised to consult the appropriate supplemental documentation listed in Appendix B.

Functional Overview

The Bristol Babcock 33XX controller functions as the master station on a master / slave communication link. A port on the 33XX is connected via a standard RS 232 point-to-point or Multidrop link to *up to ten* ENRAF 858 type CIUs (GPU version).

The commands available over the link are described in references 1, 2, and 3 of Appendix B. Theoretically, a maximum of *thirty* 854 ATG devices may be connected to each 858 CIU.

An ACCOL 'load' containing custom calls to send data to, or request data from the ATGs must run within the 33XX. This data is held in the 33XX in the form of standard ACCOL signals. Translation between the ACCOL signals and the messages to and from the ATGs is handled by the Custom Module firmware.

Appendix A provides a number of sample ACCOL program excerpts containing calls which pass data between the 33XX and the ATG.

Each port of the 33XX can be associated with a separate communication link to an 858 link.

All available read / write commands are initiated by the 33XX. All operations will be under control of an ACCOL program. No automatic polling is performed by the Custom Module - any periodic polling for input must be performed by the ACCOL load, via appropriate custom calls within an ACCOL task running at an appropriate rate.

COMMUNICATIONS INTERFACE

Full details of the available cable configurations are described in reference 3, *ENRAF-NONIUS Instruction Manual Series 858 Communications Interface Unit (Version 2.1, May 1994, Part No.:4416.500).* It is assumed that data sent from the 33XX will not appear at the 33XX RX line. RTS / CTS should either be looped back at the 33XX end, or looped via a modem connection. The 33XX makes no use of other modem controls, so these will need to be wired as required locally at a modem (if used).

Each 858 CIU used possesses a unique address. When the 33XX sends a command, *only the CIU specifically addressed* will respond. Thus, the 33XX treats the link to each 858 (or 854) as a logical 'point-to-point' link. Each CIU must be set to '*host*' mode.

Line Parameter Information

- 300/1200/2400 bits per second. 7 data bits (LSB first), start bit, one stop bit, parity selectable (odd or even).
- Asynchronous RS 232. Should be compatible with 33XX RS 423, or an interface converter may be required. Provisions of any such hardware are not addressed in this document. See Note below.
- All message exchanges are of the form 'message and response' with each transaction initiated by 33XX.
- A timeout on receiving a valid response message is configurable on a per-message basis via ACCOL. This timeout must be long enough to allow for the CIU setting of 'System Timeout' and 'Turnaround delay' (see ref 3, Appendix B). The number of 'retry' re-transmissions is configurable. A command will not be sent until the response to a previous command sent is received (or the number of retries is exhausted). The user should keep in mind that if timeouts of too great a length of time are chosen, then the whole link (to all CIUs on the link) may be held up by the delay in completing an individual transaction (if, for instance, a single ATG device is not functioning, or not responding).

A hold-off time is configurable via ACCOL as well, if required to leave a 'line-idle' time before a command is sent from the 33XX.

NOTE: The 33XX actually transmits using RS423. Some RS 232 implementations are not RS 423 compatible. In such cases, an additional 'level matching' hardware may be required the details of which are not within the scope of this document.

DESCRIPTION OF RECORD FORMATS & USAGE

The 854 is capable of utilizing several protocols depending upon the setting of item 'GT', which selects the 'Type of Instrument (TOI)'. For this type of interface, GT must be set to 'B', which selects a protocol of the type compatible with an 811 servo gauge.

In addition, CIU Individual Commands are processed and answered by the CIU only. Some support is provided for these, as they form a useful diagnostic tool.

General Command Format

All commands are of the form: Command / Answer, with all commands being sent by the 33XX, and corresponding answers returned by either the 854 ATG (via the 858 CIU) or directly by the CIU.

The meaning of each command / answer type is governed by the 'Type of Record', or TOR field. For general use, Data Request messages, Operational messages and Identification messages are recommended. 'Item messages' have a TOR of 'Z', and allow low level access to 854 data. However, it is possible that subsequent versions of 854/858 products from ENRAF will change the use and availability of some Items, so it is advisable that users consult appropriate ENRAF documentation for this information.

ENRAF-NONIUS 854 ATG Interface

The following describes the format of all available commands and answers. Mnemonics used are described subsequently. Additional details of the available 'Item' messages are provided in references 1 and 2 of Appendix B.

All commands to the 854 (with the exception of those with TOR = Z) have the following format:

Byte	**Mnemonic**	**Description**
0	STX	ASCII STX character
1	a	CIU address, ASCII 0 to 9
2,3	nn	854 Transmission address, ASCII (00 to 99).
4	i	TOI, *always ASCII 'B' for 854 ATG.*
5	r	TOR
6	ETX	ASCII ETX character
7	BCC	Block Check Character

Command / Answer Record Data

The following describes data found in Command / Answer records (discussed later).

Mnemonic	size (bytes)	Contents	Description
a	1	0 to 9 (ASCII) '@'	CIU address For broadcast
nn	2	00 to 99 (ASCII) *n,n*,**	854 transmission address For 'group' commands (n=1 to 9)
i	1	B	TOI- Type of Instrument. Always B for 854 commands.
r	1		TOR - Type of Record (854 messages):
		A to F	854 Data Request messages.
		N,O,Q,S,T,U, W	854 Operational messages.
		X	854 Identification message.
		Z	854 Item message.
as	1		Status of alarms in the gauge (in decreasing priority order):
		F	Alarm data error - hardware/software error - no previous store command - 854 in service mode
		C	motor limit switch
		B	block or freeze active
		H	high alarm
		L	low alarm
		-	no alarm

Mnemonic	size (bytes)	Contents	Description
llllll	1		Level value, given in ASCII characters with MSB first. Leading zeroes are transmitted. The value returned depends upon the setting of Item 'LD'. *Only levels in feet or meters may be returned via this message.* If 'LD' contains an 'I' (inches) or 'P' (fractions), then an error code of FFFFFF will be returned. Requesting levels in fractions or inches is possible using the 'Z' record (described later).
		0xxxxx	854 level dimension millimetres or -
		0xxxxx	level in 0.001 feet
		FFFFFF	error -not available or invalid -units error (as above)
		999999	error

Mnemonic	size (bytes)	Contents	Description
ls	1		Status of level information in the gauge (in decreasing priority order):
		F	Level information invalid, -hardware / software error, -no previous store command. -854 in service mode.
		C	Motor limit switch
		B	Block or freeze active
		L	Locktest or Calibrate active.
		T	Gauge searching for level, or test gauge, balance test, or measure frequency command active.
		W	Water found.
		D	Searching for water (downward).
		-	Valid level
s	1		Temperature sign
		F	Invalid Temperature.
		-	Negative Temperature.
		+	Positive Temperature.

Mnemonic	size (bytes)	Contents	Description
ttttt	5		Temperature Value:
		xxxxx	Temperature in 1/100 C, or 1/100 F.
		FFFFF	Invalid temperature.
ts	1		Temperature Status:
		F	Invalid temperature, temperature error, no previous store command.
		-	Valid temperature.
soft	4		Version number of software installed on XPU board.
		A*a.b*	Example: A1.0, where *a* = version number and *b* = release number.
sv	2		Software version
		ab	Example: 10 for version 1.0 (MSB first).
fb	1		Field transmission baud rate
		L	1200 baud
		H	2400 baud
msb	1		Highest nibble of switch SK3,
		@,A,B,...O	refer to *ENRAF-NONIUS Instruction Manual Series 858 Communications Interface Unit (Version 2.1 May 1994 Part no. 4116.500)*

Mnemonic	size (bytes)	Contents	Description
lsb	l		Lowest nibble of switch SK3.
		@,A,B,...O	Refer to *ENRAF-NONIUS Instruction Manual Series 858 Communications Interface Unit (Version 2.1 May 1994 Part no. 4116.500)*
f1	1	(ASCII)	Free Line Test character:
		-	All lines free.
		1	Line 1 occupied.
		2	Line 2 occupied.
		3	Lines 1 & 2 occupied.
		4	Line 3 occupied.
		5	Lines 1 & 3 occupied.
		6	Lines 2 & 3 occupied.
		7	All lines occupied.
ls	1		Test for short circuit in line selection logic:
		-	No failure.
		F	Failure
		X	Test not performed (lines not free).
ll	1		Local loopback test result.
		-	No Failure.
		F	Failure.
		X	Test not executed (lines not free).

Data Request Messages

After receipt of a Data Request message, the 854 will respond with the requested data. *Note: If no TPU is installed, the temperature portion of the response will be excluded.*

TOR	Description
A	Send alarm status.
B	Send alarm status & level.
C	Send alarm status & temperature.
D	Send alarm status & level & temperature.
E	Send stored alarm status & level.
F	Send stored alarm status & level & temperature.

The answer records returned by the 854 corresponding to Data Request messages are as follows.

Answer Record	Contents
A	STX a nn B A as ETX BCC
B	STX a nn BB as ls llllll ETX BCC
C	STX a nn B C as ts s ttttt ETX BCC
D	STX a nn B D as ls llllll ts s ttttt ETX BCC
E	STX a nn B E as ls llllll ETX BCC
F	STX a nn B F as ls llllll ts s ttttt ETX BCC

Operational Command Messages

After receipt of an Operational Command message such as those shown below, the 854 will always respond with a type A answer record (send alarm status).

TOR	Description
N	Block the displacer.
O	Raise the displacer continuously (Locktest).
Q	Quit water bottom measurement.
S	Store alarm status, level & temperature.
T	Raise displacer 5 seconds, then lower again (TEST).
U	Reset block, unlock or test.
W	Search for water level (descend displacer).

Identification Request Message

After receipt of an identification request message (TOR = 'X'), the 854 will respond with the following identification data in an X answer record.

STX a nn B X 854_soft ETX BBC

Item Messages

An Item Message, specified by a TOR of 'Z' signifies sending Items *to*, or requesting Items *from* the 854. The 'Z' record allows access to nearly all Items used within the 854 at a low level of access. The Items shown below are prescribed as being available for use and 'frozen' according to current ENRAF standards. Additional Items may also be available, please consult references 1 and 2 of Appendix B for additional details.

Users of 'Items' may be required to become 'registered users' with ENRAF-NONIUS to insure that any Items used will continue to be available in subsequent upgrades to ENRAF firmware. Users are advised to contact ENRAF-NONIUS for further details.

A 'Z' request / answer record has the following structure:

Byte	**Mnemonic**	**Description**
0	STX	ASCII STX character.
1	a	CIU address (ASCII 0 to 9).
2,3	nn	Transmission address (ASCII 00 to 99).
4	i	TOI, always ASCII 'B' for 854 gauges.
5	r	TOR, type of record = 'Z' for Item Messages.

Byte	Mnemonic	Description
6	Data Field	The Data Field commences with an Item, identified by its *2 character abbreviation*. This item may either be a *command, request or a setting*. In the case of a setting, the item is followed by data. The assign character (=) is used to separate the Item and associated data. Every received command and setting is acknowledged by the '&' character following the item. Any error detected is identified by the item request abbreviation, followed by the '!', and then an error code.
n-1	ETX	ASCII ETX character.
n	BCC	Block Check Character.

Sample Item Message Commands

The following are examples of item message commands and corresponding answers.

Command	From 3330/35	Answer
BL (Block command)	STX a nn B Z BL ETX BCC	STX a nn B Z BL& ETX BCC
DF command with data (set display format)	STX a nn B Z DF=a ETX BCC	STX a nn B Z DF=A& ETX BCC
HA request data (high alarm level)	STX a nn B Z HA ETX BCC	STX a nn B Z HA012.2345 ETX BCC
Command error QQ (QQ =unknown Item)	STX a nn B Z QQ ETX BCC	STX a nn B Z QQ!051 ETX BCC

CIU Individual Commands

These commands are sent to an individual CIU and may be used to request a CIU to perform a self-test, or to report identification. These messages do not contain a transmission address field.

Command	From 3330/35	Answer
T (CIU Self Test)	STX a i T ETX BCC	STX a R T sv sv fb msb lsb et fl ls 11 11 11 ETX BCC, (where the three bytes 11 11 11 are for switches TL1, TL2, TL3 respectively.)
X (CIU Identification)	STX a i X ETX BCC	STX a R X sv sv fb msb lsb ETX BCC

Gauge Group Commands

Gauge Group commands are 'broadcast' commands sent to a CIU, which passes on the commands or requests to the selected field devices. Only simple commands are valid, no data can be requested, as no response comes from the field devices - the CIU forms a 'timeout' response itself (S command), with e=0 if no errors detected.

Note: *there is no way of verifying if the commands have been carried out by the field units.*

General Gauge Group Command Format

From 3330/35	Answer
STX a nn i r ETX BCC	STX a @ e ETX BCC

PROTOCOL CONSIDERATIONS

Calculation of BCC Field

Calculation of the Block Check Character field is a *7* bit binary sum without carry, with STX excluded and ETX included.

Transmission Protocol Timings

It may be necessary to allow a line 'idle' time before sending a message. This may be specified by parameter *P2*. Response timeouts should allow for both normal and worst case response times. This may be specified in the Custom Module signal list for each request. Additionally, an allowance must be made for 'turnaround delay' and 'system timeout' periods *(please see reference 3, Appendix B for additional information).*

In the event of *no* valid response being received within the timeout period, retries may be performed as specified by parameter *P1*. Once a CIU has received a command, and is preparing an answer, it will transmit ASCII 'ack' characters to the 33XX at approximately 30 ms intervals. This causes the 33XX Custom Module to restart its response timeout. If an 858 CIU fails in such a way that it sends out continuous 'acks', then the Custom Module will never timeout. The timeout record may also be sent to the 33XX when a field transmission error occurs. This timeout record may interrupt the transmission of an answer record in progress, so the 33XX must continue to poll an STX character to account for this.

ACCOL USER INTERFACE

General Description

Communication is achieved in the standard way, using the Custom Module statement within an ACCOL executing task (*not* TASK 0). The Custom call requires that a signal list providing details of the requested operation, be specified.

Port Configuration Characteristics

The characteristics of the port used must be manually configured according to the parameter field values shown below which are specific to 854 ATG mode.

Parameter Field	**Value**
MODE	The value of this field should be set to ***22*** to indicate 854 ATG mode.
BAUD	This field should be set to a value corresponding to the communication baud rate (110, 300, 600, 1200, 2400, 4800 or 9600), keeping in mind that *the target hardware only supports 300 / 1200 /2400).*
CHARACTER LENGTH	This field is not used. The number of bits per character is fixed internally at ***7***
STOP BITS	This field is not used. The number of stop bits is fixed internally at ***1.***
PARITY	This field should be set to *Odd, Even, or None to indicate the type of character parity to use.*
P1	The value of this field indicates the number of retries if no valid response is received.

Parameter Field	Value
P2	The value of this field indicates the amount of *idle time* measured in milliseconds (ms). ***Note**: The idle time must be a value less than the rate at which messages are queued in order to prevent a backlog of messages within the ACCOL task queue. Such a backlog could potentially result in node failure.*

ACCOL Terminal Assignments

The following describes the terminal values appropriate for the Custom Module when configured for 854 ATG mode.

MODE	A value of *22* indicates 854 ATG mode.
LIST	The number of the signal list which contains the signals used by this module to control the interface. This signal list is referred to as the '854 ATG signal list'. It is described in greater detail in the *854 ATG Signal List* portion of this document.
STATUS	The value of this terminal is a status code representing the module's status. The status code is used to indicate various communications states & error conditions. Communication & processing of reply messages are aborted when the status code is negative. The section of this document referred to as *Status Code Definitions* contains a list of possible status codes & their descriptions.

Status Code Definitions

Code	Definition
0	Communication completed successfully.
1	Communication requested, waiting to send.
2	Command message sent, waiting for reply.
10	No temperature data available.
101	Format Error: An input signal was control inhibited. (Formats only)
102	Format Error: Attempt to store into a constant. (Formats only)
103	Format Error: An input string signal value was truncated. (Formats only)
104	Format Error: Attempt to store into a Read Only Data Array
-2	Invalid ATG signal list number specified.
-3	Invalid port number specified.
-4	Invalid CIU address specified.
-5	Invalid transmission address specified.
-6	Invalid TOI specified.
-7	Invalid TOR specified.
-8	Bad timeout specified.
-9	Invalid input I/O list number specified.
-10	Invalid input format number specified.
-11	Invalid output I/O list number specified.
-12	Invalid output format number specified.
-13	Input format specified without list.

Code	Definition
-14	Output format specified without list.
-15	Receive character overrun detected.
-16	Receive character parity error detected.
-17	Receive character framing error detected.
-18	Receive message security (BCC) failed.
-19	Timed out waiting for response.
-20	Invalid protocol characters received.
-21	Timed out waiting for clear to send, or other handshake.
-22	Unexpected I/O failure.
-32	Bad CIU echo returned.
-33	Bad transmit address echo returned.
-34	Bad TOI echo returned.
-35	Bad TOR echo returned.
-36	Bad alarm status value returned.
-37	Bad level status value returned.
-38	Bad level signal given in load.
-39	Bad level data value returned.
-40	Bad temperature status value returned.
-41	Bad temperature signal given in load.
-42	Bad temperature data value returned.
-43	Invalid I/O list size given in load.

Code	Definition
-101	Format error: Unsupported field descriptor.
-102	Format error: Attempt to use signal beyond list end.
-110	Format error: Signal must be analog.
-111	Format error: Signal must be string.
-116	Format error: Attempt to go off end of buffer.
-140	Format error: Unexpected character in numeric value.
-141	Format error: Unknown format detected.
-200 to -209	Timeout message received from CIU (with error code 0=-200, 1=-201...)
-1000 to -10999	Error code returned by 854 (corresponding to 854 error code 000 to 999, *see reference 2 of Appendix B*,) negate and subtract 1000 to get error code returned by 858 / 854.
-20000	Error code with unknown format.

854 ATG Signal List

The signal list specified via the Custom Module's list terminal must be organized as follows. Some fields have various meanings depending upon the command code used. *Please refer to the examples in Appendix A for additional information on this topic.*

Signal 1 **Port Number** (used for all commands)

An analog signal whose value represents the 33XX port number to be used for communication with the 858 CIU. The port must be a Custom port configured for 854 ATG mode.

The values are assigned as follows:

Signal Value	Port Used for Communication
1.0	A
2.0	B

3.0	C
4.0	D

Signal 2 CIU Address (used for all commands)

An analog signal whose value specifies the CIU address. Valid values are 0 to 9. (Converted to ASCII by the Custom Module.) If a value of '1000' is given, then this specifies a 'general purpose' command. The entire content of the output / input messages between STX and ETX is then under format control.

Signal 3 Transmission Address (used for commands *to* the 854)

This is an analog signal whose value specifies the address on the ENRAF field communication devices. Valid values are 0 to 99. For device group commands the value 300 represents the address '*' (wildcard), the values of 100 to 109 indicate an address of *n, while 200 to 209 indicate n* *(see reference 3, Appendix B).* A value of 1000 is used to select CIU direct commands.

Signal 4 Type of Instrument (TOI) (used for all commands)

This is a string signal (1 character) whose value specifies the ENRAF TOI. For commands to the 854, this is always set to 'B'. Other values are allowed for CIU commands and for possible future expansion:

P = to address CIU-GPP version individually (for future expansion),
R = to address CIU-GPU version individually,
@ = to address any CIU individually. @ may be used to address any type of field device with a given transmission address. Other upper case alphabetic values are also allowed for future expansion.

Signal 5 Type of Record ID (TOR) (used for all commands)

This is a single character string signal specifying the TOR.
Valid values are as follows:

Command Type	Valid TOR (ASCII character)
Data Request	A, B, C, D, E, F
Operational	N, O, Q, S, T, U, W
Identification	X
Item	Z

CIU command X, T

(Other upper case alphabetic characters are allowed and treated as 'Z' commands.)

Signal 6 Input List Number (used for all commands)

This is an analog signal providing the number of a list which contains signals to store the input data for the given command.

The contents of the input list is given as follows:

For TOR = A (also for TOR = N, O, Q, S, T, U W)**:**
Input list, Signal 1 : Alarm status signal.

For TOR = B:
Input list, Signal 1: Alarm status signal.
Input list, Signal 2: Level status signal.
Input list, Signal 3: Level signal.

For TOR = C:
Input list, Signal 1: Alarm status signal.
Input list, Signal 2: Temperature status signal.
Input list, Signal 3: Temperature signal.

For TOR = D:
Input list, Signal 1: Alarm status signal.
Input list, Signal 2: Level status signal.
Input list, Signal 3: Level signal.
Input list, Signal 4: Temperature status signal.
Input list, Signal 5: Temperature signal.

For TOR = E:
Input list, Signal 1: Stored alarm status signal.
Input list, Signal 2: Level status signal.
Input list, Signal 3: Level signal.

For TOR = F:
Input list, Signal 1: Stored alarm status signal.
Input list, Signal 2: Level status signal.
Input list, Signal 3: Level signal.
Input list, Signal 4: Temperature status signal.
Input list, Signal 5: Temperature signal.

For TOR = X:
Input list, Signal 1: Version number string.

For TOR = Z:
Input list: This will be a mixture of string signals, analogs or digitals, depending upon the item requested. At its simplest, this can be a single string signal, large enough to hold the entire expected answer record. In this way it is possible for the ACCOL load to receive any reply received from the 854, though processing of the string signal within the ACCOL program will be limited. More advantageous is the use of string signals to handle the static part of the data field, and the use of analog or logical signals together with the input format to handle the data returned. *This is more clearly demonstrated by the examples in Appendix A.*

Signal 7 Reply Timeout (used for all commands)

This is an analog signal whose value is equivalent to the amount of time allowed to wait for a reply message. This value is in units of seconds with a resolution of 1 msec.

Signal 8 Done (used for all commands)

This is an analog or logical signal that indicates completion of a communication request. If a logical signal is used, it will be set FALSE when the communication request is initiated and will be set TRUE when the communication request is completed. An analog signal will be incremented. The Custom Module's STATUS terminal is updated at the same time as this signal.

Signal 9 Output List Number
(Used only for TOR=Z, CIU & General purpose commands)

This is an analog signal giving the number of a list of signals to be used to generate the data field of a 'Z' record. As with the input list for a TOR of Z described above, this can either be a string signal which contains the whole of the output data field, or a combination of string signals, analog, and logical signals interpreted using the output format. *For further information, please refer to the examples in Appendix A.*

Signal 10 Format Number for Input List
(Used only for TOR=Z, CIU & General purpose commands)

This is an analog signal providing the number of a format list to be used to translate between the data field of a 'Z' answer record and the ACCOL signals used for input.

Description of Data Returned in Input List Signals

Alarm Status

An analog signal returned as follows:

Value	Description
-1	Alarm Data Error (F)
-2	Motor Limit Switch (C)
-3	Block or freeze active (B)
-4	High alarm (H)
-5	Low alarm (L)
-10	Other value returned.
0	No alarm.

Level

An analog signal in which (providing no error is indicated by level status) will be returned the level as a positive value (in meters, or feet, depending upon gauge configuration).

The raw value (in units of millimeters, or 0.001 ft) is divided by 1000 inches. The value ranges from 0 to 99.999. In addition, 999.999 may be returned on error.

Level Status

An analog signal returned as follows (given in decreasing priority, *see reference 1, Appendix B).*

Value	Description
-1	Level information not valid(F)
-2	Motor Limit Switch (C)
-3	Block or freeze active (B)
-4	Locktest or calibrate active (L)

Value	Description
-5	Searching for level, or test gauge, balance test or measure frequency command active(T).
-6	Water found (W)
-7	Searching for water (downwards) (D)
-10	Other value
0	Valid level.

Temperature

An analog signal in which (providing no error indicated by temperature status) the temperature will be returned as a value (in degrees C or F, depending upon gauge configuration). The raw value (in units of 0.01 C or 0.01 F) is divided by 100 in the Custom Module to give a value range of -999.99 to +999.99.

Temperature Status

An analog signal returned as follows (given in decreasing priority order, *see reference 1, Appendix B*).

Value	Description
-1	Temperature data not valid (F).
0	Valid temperature.

Stored Alarm Status

Identical to the Alarm Status Signal previously described.

Version Number

An ACCOL string signal which contains the version number, such as,'854 A1.0'. The allocated string must be large enough to contain the version number returned. Formats may be used to parse the numerical portion of the version into analog signals, if required.

Signal 11 Format Number for Output List
(Used only for TOR=Z, CIU & General purpose commands)

This is an analog signal providing the number of a format list to be used to translate between the ACCOL signals and the data field of a 'Z' command record.

Formats for the 854 ATG

Formats are defined in the same way as ACCOL logger formats. Types of formats are the usual ACCOL AIC structures, but are interpreted uniquely by this interface. Only a subset of the possible format field descriptors are valid for the 854 ATG interface. The formats are mainly used for type 'Z' item commands and answers, but may also be used for General Purpose commands.

The formats are only used to translate between ACCOL analog and logical signals and the data field of 'Z' command / answer records. Where strings are specified in the input / output lists, no format is used. The length of the string dictates how many characters are transferred directly to / from the input / output data field. unless a corresponding 'T' format is present at the correct place in the format list.

Note: The 854 requires Item values to conform to a precise format. These formats are not always the same as given by the ENRAF documentation. It is advisable that an ENRAF 'Pet' terminal is used to verify the formats required during commissioning.

'CSTn:m' formats are used to select various options controlling the format of numbers in the current format block only. 'm' should be specified as '1' to set the option *on* and '0' to turn the option *off*.

Please refer to the samples in Appendix A for practical use examples.

The field descriptors and their functions are as follows:

Descriptor	**Function**
Fx,y	This field descriptor is used for input or output to ACCOL analog signals to / from ASCII encoded data fields, in a normal, 'fixed point' format (+aaaa.bbbb). For input, the data field is accepted as it comes, with the value converted to an ACCOL signal, the **'x'** represents the total field size, including the sign. **'y'** is the number of places after the decimal point.
Ex,y	This field descriptor is used for input or output to ACCOL analog signals to / from ASCII encoded data fields, in a normal 'exponential' format (+.bbbbbbbE+04). For input the data field is accepted as it comes, with the value converted to an ACCOL signal. **'x'** represents the total field size, including the signs and **'E'**. **'y'** is the number of places after the decimal point.

Descriptor	Function
Ix	This field descriptor is used for input or output to ACCOL signals to / from ASCII encoded data fields, in a normal 'integer' format (+aaaa). For input, the data field is accepted as it comes, with the value converted to an ACCOL signal **'x'** represents the total field size, including the sign.
x	This field descriptor is used to skip a character (byte) within the input data field, or (within a group of VLs, as described below, to skip bits).
CST1	This is set to specify to that the decimal point returned / expected from the 854 is represented by a *comma* rather than as a *period*.
CST2	This is set to specify that the mantissa of an 'E' format contains an ASCII 0 character before the decimal point a (0.xxx rather than .xxx).
CST3	This is used to specify on input of E format numbers, that no 'E' should be expected, (0.xxxx+01, rather than 0.xxxxE+01).
CST4	This is used to specify that on output, E formats should not contain 'E' character (0.xxxx+01, rather than 0.xxxxE+01).
CST5	This is used to specify that positive values for I and F formats do not require a '+' sign.
VL	This field descriptor is used for input or output of logical values. It operates on bits within the current input / output character, and should therefore be used only in groups of 8. (Additionally, it may be used with X to skip bits to make up to a total of 8.)

APPENDIX A ~ ACCOL EXAMPLES

The following ACCOL program extract examples are based on an 854 ATG connected to a 33XX via an 858 CIU-GPU version, using port C of a 33XX.

Port C line at 2400 bps, 7 bit characters, 1 stop bit, odd parity, 854 ATG mode (22), idle time of 60ms. 0 retries.

Port details:

```
PORT_C      CUSTOM    2400  BIT_7      SBIT_1 PARITY_O     PARAM:22 0 60
```

Data Request

In this example, the ATG is requested to send alarm status, level and temperature (TOR=D). The request can be sent every n seconds (controlled by the ACCOL task rate for Task 10). Status signals are each returned as single analog values.

```
  *SIGNALS
PORT.NUM.1          A    3.0000000      (Port C on 33XX)
CIU.ADDR.1          A    5.0000000      (CIU address)
TX.ADDR.1           A    1.0000000      (Transmission address)
TOI.TYPE.1          S    LEN:1 'B'      (TOI type)
TOR.TYPE.1          S    LEN:1 'D'      (TOR type)
IO.LIST.1           A    11.000000      (List number, for signals)
REPLY.TIMOUT.1      A    2.0000000      (2 seconds allowed for response)
DONE.1                   0.0000000      (Completion code)
ALARM.STATUS.1      A    0.0000000      (To contain alarm status value)
LEVEL.STATUS.1      A    0.0000000      (To contain level status value)
LEVEL.1.1           A    0.0000000      (To contain level value)
TEMPER.STATUS.1     A    0.0000000      (To contain temperature status
                                        value)
TEMPER.1.1          A                   (To contain temperature value)
ATG1.STATUS.1       A                   (Status signal)

*TASK 10

10 *CUSTOM
MODE                     22.0000000  (mode # for 854 ATG mode)
LIST                     1.0000000   (Custom module parameter list #)
STATUS                   ATG1.STATUS.1  (Custom module status signal)
```

```
*LIST 1
   10 PORT.NUM.1
   20 CIU.ADDR.1
   30 TX.ADDR.1
   40 TOI.TYPE.1
   50 TOR.TYPE.1
   60 IO.LIST.1
   70 REPLY.TIMOUT.1
   80 DONE.1

*LIST 11
   10 ALARM.STATUS.1
   20 LEVEL.STATUS.1
   30 LEVEL.1.1
   40 TEMPER.STATUS.1
   30 TEMPER.1.1
```

Operational Request

In this example, the ATG is requested to send an operational request to 'Search for Water Level'.

```
  *SIGNALS
PORT.NUM.1          A     3.0000000   (Port C on 33XX)
CIU.ADDR.1          A     5.0000000   (CIU address)
TX.ADDR.1           A     1.0000000   (Transmission address)
TOI.TYPE.1          S     LEN:1 'B'   (TOI type)
TOR.TYPE.1          S     LEN:1 'W'   (TOR type)
IO.LIST.1           A     11.000000   (List number for signals)
REPLY.TIMOUT.1      A     2.0000000   (2 seconds allowed for response)
DONE.1                    0.0000000   (Completion code)

ALARM.STATUS.1      A     0.0000000   (To contain alarm status value)
ATG1.STATUS.1       A     0.0000000   (Status signal)

*TASK 10
10 *CUSTOM
MODE                      22.0000000  (mode # for 854 ATG mode)
LIST                      1.0000000   (Custom module parameter list #)
STATUS                    ATG1.STATUS.1   (Custom module status signal)

*LIST 1
   10 PORT.NUM.1
   20 CIU.ADDR.1
   30 TX.ADDR.1
   40 TOI.TYPE.1
   50 TOR.TYPE.1
   60 IO.LIST.1
   70 REPLY.TIMOUT.1
   80 DONE.1

*LIST 11
    10 ALARM.STATUS.1
```

Software Version Request

In this example, the ATG is requested to send its software version. The entire version number is to be returned as an ACCOL string signal.

```
  *SIGNALS
PORT.NUM.1          A     3.0000000   (Port C on 33XX)
CIU.ADDR.1          A     5.0000000   (CIU address)
TX.ADDR.1           A     1.0000000   (Transmission address)
TOI.TYPE.1          S     LEN:1 'B'   (TOI type)
TOR.TYPE.1          S     LEN:1 'X'   (TOR type)
IO.LIST.1           A     11.000000   (List number for signals)
REPLY.TIMOUT.1      A     2.0000000   (2 seconds allowed for response)
DONE.1                    0.0000000   (Completion code)

SOFT.VERS.1         S     LEN:32      (To contain returned version string)
ATG1.STATUS.1       A     0.0000000   (Status signal)

*TASK 10
10 *CUSTOM
MODE                      22.0000000  ( Mode # for 854 ATG mode)
LIST                      1.0000000   (Custom module parameter list #)
STATUS                    ATG1.STATUS.1   (Custom module status signal)

*LIST 1
   10 PORT.NUM.1
   20 CIU.ADDR.1
   30 TX.ADDR.1
   40 TOI.TYPE.1
   50 TOR.TYPE.1
   60 IO.LIST.1
   70 REPLY.TIMOUT.1
   80 DONE.1

*LIST 11
   10 SOFT.VERS.1
```

Item Commands

The following are examples of Item commands.

Set Display Format

The following example sends an Item command to set the display format to 'A'.

```
   *SIGNALS
PORT.NUM.1          A     3.0000000   (Port C on 33XX)
CIU.ADDR.1          A     5.0000000   (CIU address)
TX.ADDR.1           A     1.0000000   (Transmission address)
TOI.TYPE.1          S     LEN:1 'B'   (TOI type)
TOR.TYPE.1          S     LEN:1 'Z'   (TOR type)
IO.LIST.1           A     11.000000   (List number for signals)
REPLY.TIMOUT.1      A     2.0000000   (2 seconds allowed for response)
DONE.1                    0.0000000   (Completion code)

OUTPUT.LIST.1       A     12.000000   (Output list)
INPUT.FORM.1        A     21.000000   (Input format)
OUTPUT.FORM.1       A     22.000000   (Output format)
OITEM.SET.1         S     LEN:3 'DF='(First part of output data field)
OITEM.VAL.1         S     LEN:1 'A'   (Second part of data field)
ATG1.STATUS.1       A     0.0000000   (Status signal)
```

```
*TASK 10
10 *CUSTOM
MODE                    22.0000000  (mode # for 854 ATG mode)
LIST                    1.0000000   (Custom module parameter list #)
STATUS                  ATG1.STATUS.1   (Custom module status signal)

*LIST 1
    10 PORT.NUM.1
    20 CIU.ADDR.1
    30 TX.ADDR.1
    40 TOI.TYPE.1
    50 TOR TYPE.1
    60 IO.LIST.1
    70 REPLY.TIMOUT.1
    80 DONE.1
    90 OUTPUT.LIST.1
   100 INPUT.FORM.1
   110 OUTPUT.FORM.1

*LIST 11
   10 OITEM.SET.1
   20 OITEM.VAL.1
```

Set High Alarm Level

The following example sends an Item command to request the setting of the high alarm level. The returned value is to be placed in an ACCOL string signal.

```
   *SIGNALS
PORT.NUM.1          A     3.0000000   (Port C on 33XX)
CIU.ADDR.1          A     5.0000000   (CIU address)
TX.ADDR.1           A     1.0000000   (Transmission address)
TOI.TYPE.1          S     LEN:1 'B'   (TOI type)
TOR.TYPE.1          S     LEN:1 'Z'   (TOR type)
IO.LIST.1           A     11.000000   (List number for signals)
REPLY.TIMOUT        A     2.0000000   (2 seconds allowed for response)
DONE.1                    0.0000000   (Completion code)

OUTPUT.LIST.1       A     12.000000   (Output list)
INPUT.FORM.1        A     21.000000   (Input format)
OUTPUT.FORM.1       A     22.000000   (Output format)
OITEM.SET.1         S     LEN:2 'HA'  (Output data field)
IITEM.VAL.1         S     LEN:32      (Input data field)
ATG1.STATUS.1       A     0.0000000   (Status signal)

*TASK 10
10  * CUSTOM
MODE                      22.000000   (mode # for 854 ATG mode)
LIST                      1.0000000   (Custom module parameter list #)
STATUS                    ATG1.STATUS.1   (Custom module status signal)
```

```
*LIST 1
   10 PORT.NUM.1
   20 CIU.ADDR.1
   30 TX.ADDR.1
   40 TOI.TYPE.1
   50 TOR.TYPE.1
   60 IO.LIST.1
   70 REPLY.TIMOUT.1
   80 DONE.1
   90 OUTPUT.LIST.1
  100 INPUT.FORM.1
  110 OUTPUT.FORM.1

*LIST 11
   10 ITEM.VAL.1

*LIST 12
   10 OITEM.SET.1

*FORMAT 21
10 2X,F9.4              (skip the 'HA' echo, then interpret ASCII value)
```

The following example sends an Item command to request the setting of the high alarm level. The setting is assumed to require a data field in the form +aaa.bbbb.

```
*SIGNALS
PORT.NUM.1          A     3.0000000   (Port C on 33XX)
CIU.ADDR.1          A     5.0000000   (CIU address)
TX.ADDR.1           A     1.0000000   (Transmission address)
TOI.TYPE.1          S     LEN:1 'B'   (TOI type)
TOR.TYPE.1          S     LEN:1 'Z'   (TOR type)
IO.LIST.1           A     11.000000   (List number for signals)
REPLY.TIMOUT        A     2.0000000   (2 seconds allowed for response)
DONE.1                    0.0000000   (Completion code)

OUTPUT.LIST.1       A     12.000000   (Output list)
INPUT.FORM.1        A     21.000000   (Input format)
OUTPUT.FORM.1       A     22.000000   (Output format)
OITEM.SET.1         S     LEN:3 'HA='(Output data field, first part)
OITEM.VAL.1         A     200.345     (Value to be output)
ATG1.STATUS.1       A     0.0000000   (Status signal)

*TASK 10
10  *CUSTOM
MODE                      22.000000   (mode # for 854 ATG mode)
LIST                      1.0000000   (Custom module parameter list #)
STATUS                    ATG1.STATUS.1  (Custom module status signal)

*LIST 1
   10 PORT.NUM.1
   20 CIU.ADDR.1
   30 TX.ADDR.1
   40 TOI.TYPE.1
   50 TOR.TYPE.1
   60 IO.LIST.1
   70 REPLY.TIMOUT.1
   80 DONE.1
   90 OUTPUT.LIST.1
  100 INPUT.FORM.1
  110 OUTPUT.FORM.1

*LIST 12
   10 OITEM.SET.1
   20 OITEM.VAL.1
*FORMAT 22
10 F9.4
```

APPENDIX B ~ REFERENCES

1. ENRAF-NONIUS Protocol Manual for 854 Advanced Technology Gauge via the type CIU-GPU Version (Version 1, February 1990, Document Number:0000.564.4416.505-40)

2. ENRAF-NONIUS Instruction Manual Series 854 ATG Level Gauge (Version 2.2, November 1993, Part No. 4416.220)

3. ENRAF-NONIUS Instruction Manual Series 858 Communications Interface Unit (Version 2.1, May 1994, Part No.:4416.500)

APPENDIX C ~ TERMS & ABBREVIATIONS

ACCOL	Advanced Communication & Control Oriented Language
ack	acknowledge
AIC	ACCOL Interactive Compiler
ASCII	American Standard Code for Information Interchange
ATG	Advanced Technology Gauge
BCC	Block Check Character
C	Celsius
CIU	Communications Interface Unit
EPROM	Erasable Programmable Read-Only Memory
ETX	End Transmission
F	Fahrenheit
LSB	Least Significant Bit
ms	milliseconds
MSB	Most Significant Bit
RTS / CTS	Request To Send / Clear To Send
RS 232 / RS 423	Recommended industry Standards for serial communications connections.
STX	Start Transmission
TOI	Type of Instrument

TOR	Type of Record
TPU	Temperature Processing Unit
TX / RX	Transmit / Receive

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