



BULLETIN 1203-GD2, -GK2 & 1336-GM2 DF1 MESSAGING (FULL DUPLEX / POINT-TO-POINT)

APPLICATION NOTE

OCTOBER 20, 1999

PURPOSE

The purpose of this document is to provide information on using the DF1 Full Duplex/Point-to-Point protocol and Programmable Controller Communications Commands (PCCC) with the 1203-GD2, -GK2 or 1336-GM2. This document provides information only. Users must ensure that installations using DF1 and PCCC meet applicable codes and are suitable for the existing conditions.

WHAT THIS NOTE CONTAINS

This document contains information on the DF1 Full Duplex/Point-to-Point protocol and PCCC commands.

INTENDED AUDIENCE

This application note should be used by personnel familiar with the hardware components and programming procedures necessary to operate SCANport devices. It is also assumed that the user has some familiarity with serial communications and the programming required to implement serial protocols.

WHERE IT IS USED

The information contained in this application note is intended to address issues in many different applications. Some changes by the user may be necessary to apply the concepts of this document to a specific application.

APPLICATION CONSIDERATIONS

SCANport devices may assign different meanings to bits in the Logic Command and Status words. The usage of the Reference and Feedback words may also vary. Consult the manual for your SCANport device for more information.

FOR MORE INFORMATION

- | | |
|-----------------------|--|
| DF1 & PCCC | Data Highway/Data Highway Plus/DH-485 Communication Protocol and Command Set Reference Manual
Publication 1770-6.5.16 |
| 1203-Gx2 | Bulletin 1203 Serial Communications Module
RS232/422/485 (Using DF1 Protocol)
DH485
User Manual
Publication 1203-5.5 |

Spare Allen-Bradley Parts



DEFINITIONS

- 1203-Gx2** A 1203-GD2 (120/230vac), 1203-GK2 (24vdc) or 1336-GM2 (internal mount) Serial Communications Module.
- DF1** A serial communications protocol defined in ANSI X3.28 subparagraphs D1 and F1.
- Full Duplex** Two-way simultaneous transmission between two devices (sometimes referred to as "Point-to-Point")
- Half Duplex** Two-way non-simultaneous transmission between two or more devices (sometimes referred to as "Multi-Drop")
- PCCC** Programmable Controller Communications Commands -- the commands transmitted over DF1 that are used to control Allen-Bradley PLC's, SLC's and other devices. Sometimes referred to as "PC-Cubed".
- Sender** A device capable of sending a command message -- the device that transmits first in each message transaction.
- Responder** A device that replies to a command message.

DF1 -- SYMBOLS USED

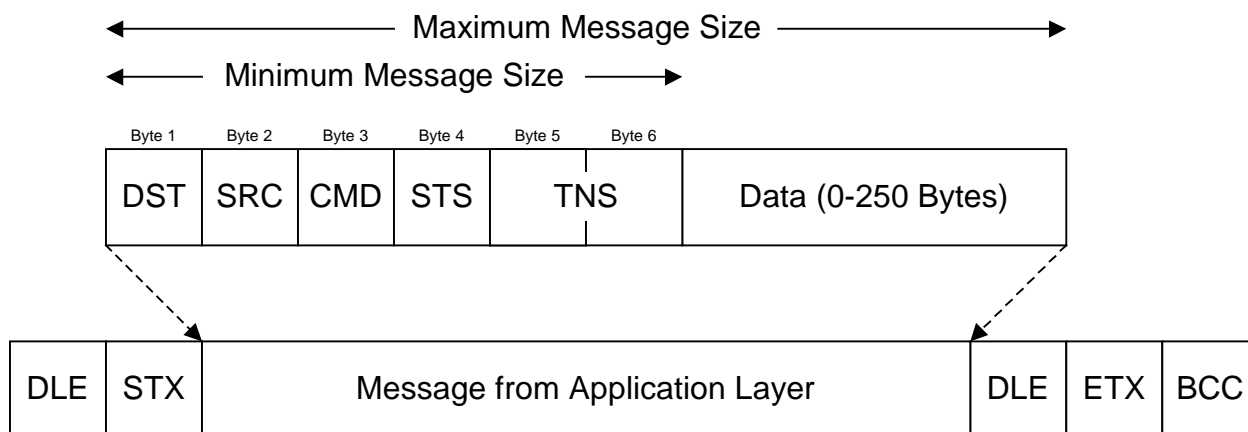
DF1 uses 8-bit characters which may be transmitted over any serial communications medium. DF1 uses certain ASCII characters to form symbols that are embedded in the serial data stream.

Control Characters

ASCII Character	Hex Value
STX	02h
ETX	03h
ENQ	05h
ACK	06h
DLE	10h
NAK	15h

Symbol	Type	Meaning
data	Data	Single byte data characters
DLE ACK	Control	Message received OK
DLE DLE	Data	Represents data of 10h
DLE ENQ	Control	Retransmit ACK or NAK
DLE ETX BCC ¹	Control	End of a message
DLE NAK	Control	Bad message received
DLE STX	Control	Start of a new message

¹ May be an 8-bit Block Check Character (2's complement modulo 256 checksum) or a 16-bit Cyclic Redundancy Check (CRC-16). Refer to the section on checksum calculation.



DF1 DATA LINK LAYER MESSAGE PACKET FIELDS

- DLE STX** Start of message flag.
- DST** Destination address -- where this message packet is going.
- SRC** Source address -- where this message packet is from.
- CMD** The command (or response to a command) this message packet contains.
- STS** The status of the device this message packet is from.
- TNS** Transaction ID number -- a response message will have the same transaction ID number as the command message it is responding to.
- FNC** Function Code -- an additional command code included in certain command messages. If used, this is always the first byte in the data block.
- EXT STS** Extended Status -- an additional status code included in response messages where the STS byte's upper nibble is set to Fh. If used, this is always the first byte in the data block.
- ADDR** Data table address inside the 1203-Gx2. Refer to the 1203-Gx2 manual for more information. The structure of the address fields within the data block varies depending on the message type.
- DLE ETX** End of message flag.
- BCC** Checksum -- may be an 8-bit Block Check Character or a 16-bit Cyclic Redundancy Check. Refer to the section on checksum calculation.



DLE STUFFING

When the control character DLE (10h) appears between the DLE STX and DLE ETX of a message it must be replaced with DLE DLE before transmission. When decoding such a message only one of the DLE bytes should be included in the BCC or CRC calculation.

CHECKSUM CALCULATION

BCC Add all bytes between DLE STX (start of message) and DLE ETX (end of message) using modulo 256. Then perform a two's complement. If DLE stuffing was used in the message data only one of the two DLE's should be included in the BCC.

CRC A CRC-16 that includes all bytes between DLE STX (start of message) and DLE ETX (end of message) and the ETX byte. If DLE stuffing was used in the message data only one of the two DLE's should be included in the CRC.

DF1 -- BASIC MESSAGE TRANSACTION

A DF1 message transaction begins when the sender transmits a command message:

DLE	STX	data	DLE	ETX	BCC ¹
-----	-----	------	-----	-----	------------------

If the responder receives the message correctly it will transmit an ACK:

DLE	ACK
-----	-----

If the responder receives the message incorrectly it will transmit a NAK:

DLE	NAK
-----	-----

If the responder does not transmit ACK or NAK the sender may transmit an enquiry:

DLE	ENQ
-----	-----

The number of times the sender will transmit an enquiry before giving up is generally programmable with a default value of three. When the responder receives an enquiry it transmits an ACK or NAK depending on the status of the last message it received.

If the responder transmits a NAK it will take no further action on the sender's message. The sender may retransmit or go on to the next message.

If the responder transmits an ACK it continues processing the sender's message and some time later will transmit a response message:

DLE	STX	data	DLE	ETX	BCC ¹
-----	-----	------	-----	-----	------------------

If the sender device receives the message correctly it will transmit an ACK:

DLE	ACK
-----	-----

If the sender device receives the message incorrectly it will transmit a NAK:

DLE	NAK
-----	-----

If the sender does not transmit ACK or NAK the responder may transmit an enquiry:

DLE	ENQ
-----	-----

The number of times the responder will transmit an enquiry before giving up is generally programmable with a default value of three.

If the sender transmits a NAK the responder should resend (the number of retries is generally programmable with a default of three retries).

After the responder receives an ACK message or reaches the enquiry or retry limit the message transaction is complete.

The **data** contained in these messages is a PCCC command or response.

¹ An 8-bit BCC or a 16-bit CRC may be used. Refer to the section on checksum calculation.



PCCC COMMAND LISTING AND EXAMPLES

The table below shows all of the PCCC messages supported by the 1203-Gx2. Examples showing the structures of the message packets for some of these commands are shown on the following pages. For more information about PCCC messages, refer to Publication 1770-6.5.16. For more information about data table addresses inside the 1203-Gx2 refer to Publication 1203-5.5.

CMD Code	FNC Code	Command Name	PLC Addressing Style
01h	n/a	Unprotected Read	PLC-2
06h	00h	Echo	n/a
	01h	Read Diagnostic Counters	PLC-2
	02h	Set Variables	n/a
	03h	Identify Host and Some Status	n/a
	04h	Set Timeout	n/a
	07h	Reset Diagnostic Counters	n/a
	09h	Read Link Parameters	Logical Address
	0Ah	Set Link Parameters	Logical Address
08h	n/a	Unprotected Write	PLC-2
0Fh	00	Word Range Write	PLC-2 System, Logical Binary, Logical ASCII (Not Symbolic)
	01	Word Range Read	PLC-2 System, Logical Binary, Logical ASCII (Not Symbolic)
	67h	Typed Write	PLC-2 System, Logical Binary, Logical ASCII (Not Symbolic)
	68h	Typed Read	PLC-2 System, Logical Binary, Logical ASCII (Not Symbolic)
	A1h	Protected Typed Logical Read with Two Address Fields	SLC500 File/Type/Element
	A2h	Protected Typed Logical Read with Three Address Fields	SLC500 File/Type/Element/Sub-element
	A9h	Protected Typed Logical Write with Two Address Fields	SLC500 File/Type/Element
	AAh	Protected Typed Logical Write with Three Address Fields	SLC500 File/Type/Element/Sub-element
	ABh	Protected Typed Logical Write with Four Address Fields	SLC500 File/Type/Element/Sub-element/Bit Mask

FRN2.02 and later firmware only



DF1 PCCC Unprotected Read (CMD = 01h) (Full Duplex/Point-to-Point)

Read Parameter 5 from the SCANport device connected to the Gx2 at address 1. (PLC = 0)

From Sender

10	DLE	Start of
02	STX	Message
01	DST	Destination
00	SRC	Source
01	CMD	Command
00	STS	Status
01	TNS lo	Unique Transaction
03	TNS hi	ID number
0A	ADDR lo	PLC-2
04	ADDR hi	Address
02	SIZE	Size in bytes
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

From Responder (1203-Gx2)

10	DLE	Message was
06	ACK	received correctly

10	DLE	Start of
02	STX	Message
00	DST	Destination
01	SRC	Source
41	CMD	Command & 40h
00	STS	Status (s/b 0)
01	TNS lo	(Same number as in
03	TNS hi	command message)
05	DATA lo	Two bytes of data
00	DATA hi	in Lo/Hi format
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

10	DLE	Message was
06	ACK	received correctly

1. All numbers shown in hexadecimal



DF1 PCCC Unprotected Write (CMD = 08h) (Full Duplex/Point-to-Point)

Write a value of 5 into Parameter 5 of the SCANport device connected to the Gx2 at address 1. (PLC = 0)

From Sender

10	DLE	Start of
02	STX	Message
01	DST	Destination
00	SRC	Source
08	CMD	Command
00	STS	Status (s/b 0)
21	TNS lo	Unique Transaction
03	TNS hi	ID number
0A	ADDR lo	PLC-2
04	ADDR hi	Address
05	DATA lo	Data in
00	DATA hi	Lo/Hi order
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

From Responder (1203-Gx2)

10	DLE	Message was
06	ACK	received correctly

10	DLE	Start of
02	STX	Message
00	DST	Destination
01	SRC	Source
48	CMD	Command & 40h
00	STS	Status (s/b 0)
21	TNS lo	(Same number as in
03	TNS hi	command message)
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

10	DLE	Message was
06	ACK	received correctly

1. All numbers shown in hexadecimal



DF1 PCCC Word Range Write (CMD = 0Fh, FNC = 00h) (Full Duplex/Point-to-Point)

Write a value of 5 into Parameter 5 of the SCANport device connected to the Gx2 at address 1. (PLC = 0)

From Sender

10	DLE	Start of
02	STX	Message
01	DST	Destination
00	SRC	Source
0F	CMD	Command
00	STS	Status (s/b 0)
E1	TNS lo	Unique Transaction
03	TNS hi	ID number
00	FNC	Function
00	OFF	Offset
00	OFF	
01	TRANS ²	Transaction Size
00	TRANS ²	in words
00	MASK	Address Mask Byte
24	ADDR	'\$' - Logical ASCII
4E	ADDR	N
31	ADDR	1
30	ADDR	0
3A	ADDR	:
35	ADDR	5
00	ADDR	Null Terminator
05	DATA lo	Data in
00	DATA hi	Lo/Hi order
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

From Responder (1203-Gx2)

10	DLE	Message was
06	ACK	received correctly

10	DLE	Start of
02	STX	Message
00	DST	Destination
01	SRC	Source
4F	CMD	Command & 40h
00	STS	Status (s/b 0)
E1	TNS lo	(Same number as in
03	TNS hi	command message)
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

10	DLE	Message was
06	ACK	received correctly

1. All numbers shown in hexadecimal.
2. Transaction Size = Number of Words to write



DF1 PCCC Word Range Read (CMD = 0Fh, FNC = 01h) (Full Duplex/Point-to-Point)

Read the value of Parameter 5 from the SCANport device connected to the Gx2 at address 1. (PLC = 0)

From Sender

10	DLE	Start of
02	STX	Message
01	DST	Destination
00	SRC	Source
0F	CMD	Command
00	STS	Status (s/b 0)
01	TNS lo	Unique Transaction
04	TNS hi	ID number
01	FNC	Function
00	OFF	Offset
00	OFF	
01	TRANS ²	Transaction Size
00	TRANS ²	in words
00	MASK	Address Mask Byte
24	ADDR	'\$' - Logical ASCII
4E	ADDR	N
31	ADDR	1
30	ADDR	0
3A	ADDR	:
35	ADDR	5
00	ADDR	Null Terminator
02	SIZE ³	Size in bytes
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

From Responder (1203-Gx2)

10	DLE	Message was
06	ACK	received correctly

10	DLE	Start of
02	STX	Message
00	DST	Destination
01	SRC	Source
4F	CMD	Command & 40h
00	STS	Status (s/b 0)
01	TNS lo	(Same number as in
04	TNS hi	command message)
05	DATA	Data in Lo byte
00	DATA	/ Hi byte order
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

10	DLE	Message was
06	ACK	received correctly

1. All numbers shown in hexadecimal.
2. Transaction Size = Number of Words to read
3. Size = Number of bytes to read



DF1 PCCC Typed Write (CMD = 0Fh, FNC = 67h) (Full Duplex/Point-to-Point)

Write a value of 5 into Parameter 5 of the SCANport device connected to the Gx2 at address 1. (PLC = 0)

From Sender

10	DLE	Start of
02	STX	Message
01	DST	Destination
00	SRC	Source
0F	CMD	Command
00	STS	Status (s/b 0)
41	TNS lo	Unique Transaction
03	TNS hi	ID number
67	FNC	Function
00	OFF	Offset
00	OFF	
01	TRANS ²	Transaction Size
00	TRANS ²	in words
00	MASK	Address Mask Byte
24	ADDR	'\$' - Logical ASCII
4E	ADDR	N
31	ADDR	1
30	ADDR	0
3A	ADDR	:
35	ADDR	5
00	ADDR	Null Terminator
99	TYPE	Data Type - Extended
09	EXT	Data Type - Array
03	EXT ³	Data Type - Size
42	EXT	Data Type - Integer
05	DATA lo	Data in
00	DATA hi	Lo/Hi order
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

From Responder (1203-Gx2)

10	DLE	Message was
06	ACK	received correctly

10	DLE	Start of
02	STX	Message
00	DST	Destination
01	SRC	Source
4F	CMD	Command & 40h
00	STS	Status (s/b 0)
41	TNS lo	(Same number as in
03	TNS hi	command message)
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

10	DLE	Message was
06	ACK	received correctly

1. All numbers shown in hexadecimal.
2. Transaction Size = Number of Words to write
3. Data Type - Size = 1 + 2 * Transaction Size



DF1 PCCC Typed Read (CMD = 0Fh, FNC = 68h) (Full Duplex/Point-to-Point)

Read the value of Parameter 5 from the SCANport device connected to the Gx2 at address 1. (PLC = 0)

From Sender

10	DLE	Start of
02	STX	Message
01	DST	Destination
00	SRC	Source
0F	CMD	Command
00	STS	Status (s/b 0)
61	TNS lo	Unique Transaction
03	TNS hi	ID number
68	FNC	Function
00	OFF	Offset
00	OFF	
01	TRANS ²	Transaction Size
00	TRANS ²	in words
00	MASK	Address Mask Byte
24	ADDR	'\$' - Logical ASCII
4E	ADDR	N
31	ADDR	1
30	ADDR	0
3A	ADDR	:
35	ADDR	5
00	ADDR	Null Terminator
01	SIZE lo ³	Size in
00	Size hi ³	Words
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

From Responder (1203-Gx2)

10	DLE	Message was
06	ACK	received correctly

10	DLE	Start of
02	STX	Message
00	DST	Destination
01	SRC	Source
4F	CMD	Command & 40h
00	STS	Status (s/b 0)
61	TNS lo	(Same number as in
03	TNS hi	command message)
99	TYPE	Data Type - Extended
09	EXT	Data Type - Array
03	EXT ⁴	Data Type - Size
42	EXT	Data Type - Integer
05	DATA	Data in Lo byte
00	DATA	/ Hi byte order
10	DLE	End of
03	ETX	Message
	BCC	Checksum (or 2 byte CRC)

10	DLE	Message was
06	ACK	received correctly

1. All numbers shown in hexadecimal.
2. Transaction Size = Number of Words to read
3. Size = Number of Words to read
4. Data Type Size = 1 + 2 * Number of Words read