GSIOC
Technical Manual

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Introduction 1

The Gilson Serial Input/Output Channel (GSIOC) is a bi-directional communications link that connects a master controller module with as many as 32 slave instruments. The master communicates with one slave at a time. When the master selects a slave for communication, it disconnects any previous slave from the channel and connects the selected one. Each slave is identified by a unique unit ID code (0 through 63).

The GSIOC was designed to meet several goals:

- The choice of an asynchronous communications format allows most existing computer equipment to serve as a system master.
- By transmitting serial rather than parallel data, cabling and interface costs are minimized.
- Differential signals from the master and slaves eliminate ground loops from the system.
- A multi-drop protocol simplifies the addition of numerous slave instruments into the system.

This technical manual describes the physical and electrical levels of the GSIOC. It also details the protocols for master/slave communication at the character level.

Physical Level 2
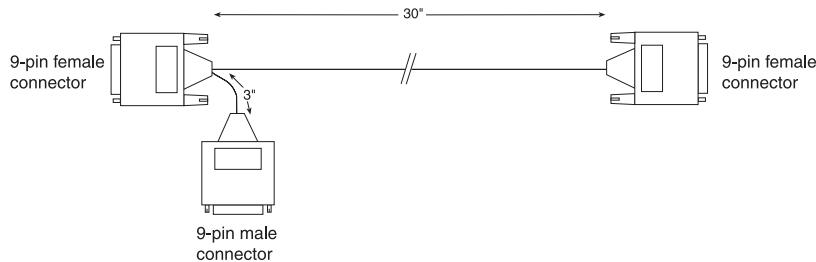
Using 9-conductor GSIOC cable, multiple slave instruments can be connected in a linear fashion from a single master instrument. For GSIOC cables longer than 50 meters, Gilson recommends that you connect a terminator (part number 36078149) to the far end of the GSIOC cable.

Note: For improved noise immunity, the instrument being controlled via GSIOC should have a metal shell 9-pin connector with the shell tied to chassis ground.
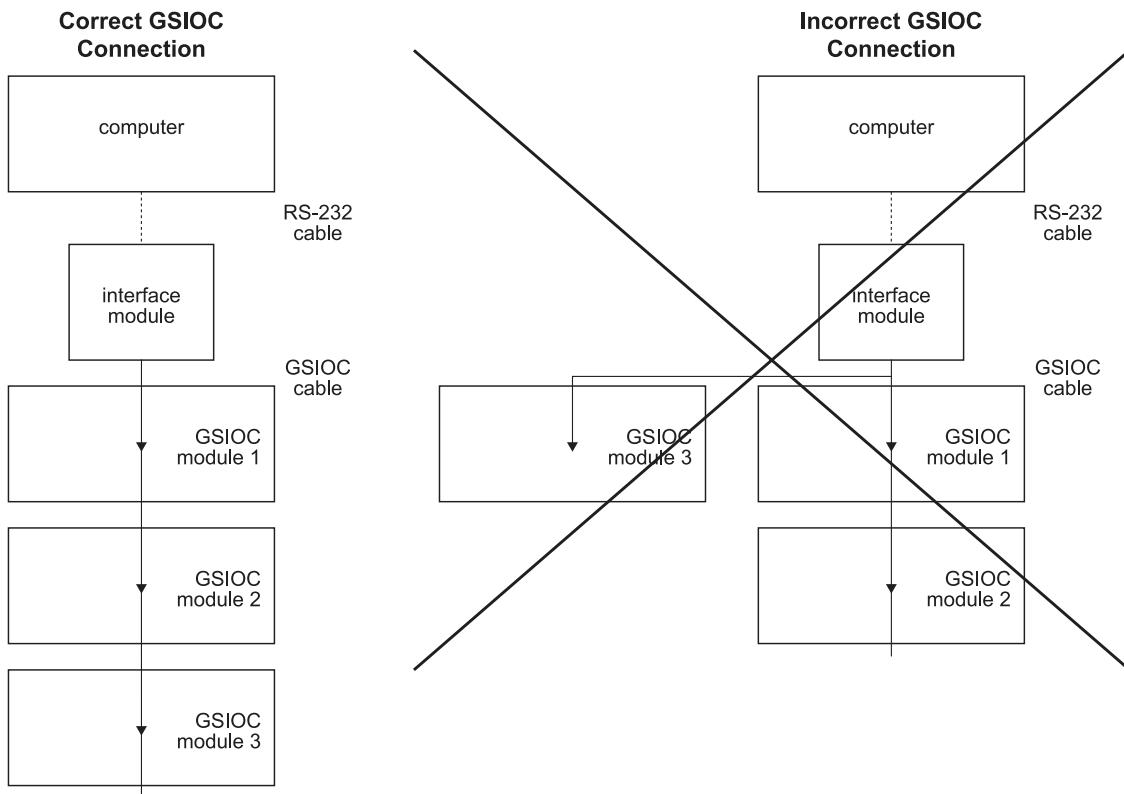
Y-Type GSIOC Cable

The shielded Y-type version of GSIOC cable is shown below. It includes two female D-connectors and one male D-connector. To link GSIOC cables, connect the male connector to the next cable's female connector (use the female connector that's not joined to the male connector). Then connect the other female connector to the instrument.

Note: Shielded GSIOC cables should be used to connect all Gilson instruments that are EMI certified. This certification is indicated on the rear panel of the instrument.

30"

9-pin female connector

3"

9-pin female connector

9-pin male connector

Linear Arrangement of GSIOC Cables
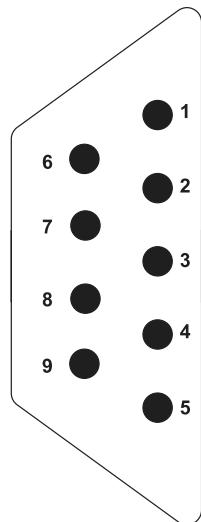
Cables should be arranged in a linear fashion. Any "Y-branching" from the main GSIOC control cable may increase noise. To reduce noise that occurs when you use very long cables, purchase a GSIOC terminator from Gilson.

Correct GSIOC Connection

computer

RS-232 cable

interface module

GSIOC cable

GSIOC module 1

GSIOC module 2

GSIOC module 3

Incorrect GSIOC Connection

computer

RS-232 cable

interface module

GSIOC cable

GSIOC module 3

GSIOC module 1

GSIOC module 2
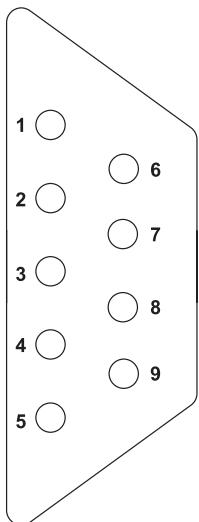
GSIOC D-Connectors

Each pin of the D-connectors is attached to one of nine wires in a GSIOC cable. Seven of the pin/wire combinations are active; two are reserved for future use.

Pin	Name	Source
1	reserved	
6	reserved	
2	–slave data	slave
7	+slave data	slave
3	–master data	master
8	+master data	master
4	–clock	master
9	+clock	master
5	optional ground	master

**male
D-connector**

**female
D-connector**

Electrical Level 3

Voltage differences between the wires of a pair represent data values on the GSIOC. The specifications for the voltages in each pair are detailed in the RS-485 standard. Receivers must also conform to RS-485 specifications. The RS-485 standard is an upgrade to the RS-422 standard.

The master continuously drives the master data pair and the clock pair.

A slave instrument drives the slave pair only when it is the selected slave.

For master instruments, an optional ground is provided by pin #5 (see table on page 2-4). Slaves that have no other ground reference source should use pin #5. However, each module is grounded to ensure compliance with the common mode voltage specification (less than five volts between slaves and the master).

Baud Rate

Information is sent between the master and slave instruments at a defined rate called the baud rate. The master and slaves must communicate at an identical rate to prevent garbled communication. The default GSIOC baud rate is 19200. Other valid baud rates are 4800 and 9600.

GSIOC Clock Pair

By definition, asynchronous communication does not require a clock. However, the GSIOC provides asynchronous communication with optional control over the clock rate. This ensures that all Gilson slave instruments communicate at the same baud rate.

Note: Gilson slave instruments are configured at the factory to sense the GSIOC clock. The clock rate is sixteen times the specified baud rate.

Termination Conditions

The GSIOC can be terminated in one of two ways.

- The master usually terminates the master end of the slave line so that it receives a break character when no slave instrument is selected. This method is called "break active" and is supported by Gilson software that controls instruments along the GSIOC.

- If you develop your own software to control instruments along the GSIOC, choose the simpler "passive" termination. This avoids error conditions that may occur when some systems detect a break character. Some old Gilson masters only support "passive" termination.

To reduce noise on long lines or lines that contain many slaves, terminate the slave end of the GSIOC as well.
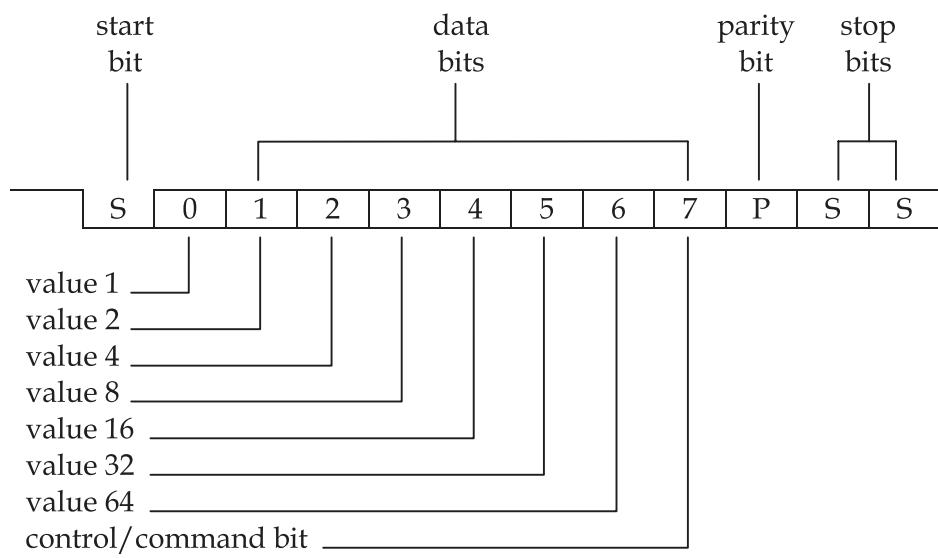
Character Level 4

Control/Command Character Format

All characters on the GSIOC are asynchronous, eight bit, even parity, half duplex with one or two stop bits.

Some characters are used by the master instrument to manage data traffic on the GSIOC. Other characters are valid data characters.

- ASCII characters 0 to 127 (0 to 7F hexadecimal) are valid data characters that do not affect connections onto the GSIOC.
- ASCII characters 128 to 191 (80 to BF hexadecimal) from the master connect slave modules with unit IDs of 0 through 63.
- ASCII characters with values from 127 to 255 from a slave indicate the final character of a slave's response to an immediate command. For more information on immediate commands, see page 5-2.
- ASCII characters 192 to 255 (CO to FF hexadecimal) disconnect every slave module.

GSIOC character

Disconnect/Connect Sequence

This is the sequence used to select a desired slave instrument:

• The master instrument sends a 255 ASCII (FF hexadecimal) character to disconnect all slaves from the GSIOC.

• Using one of the two following methods, the master instrument ensures that no slaves are active.

  - Passive (no break) termination: The master waits for a period of at least 20 milliseconds to allow all slaves to disconnect.

  - Break active: The master receives a "break" character as soon as a selected slave disconnects.

  For more information about passive termination and break active, see termination conditions on page .

• The master sends the binary name of the desired slave instrument. The value of the binary name is equal to the unit ID plus 128. For example, if a unit's ID code is 16, its binary name is 10010000.

Note: It is important to recognize the difference between a unit ID and binary name. Unit IDs (with ASCII values 0 to 63) are interpreted by the GSIOC as commands rather than IDs. To distinguish unit IDs from commands, the program sets the high bit to create a unit's binary name.
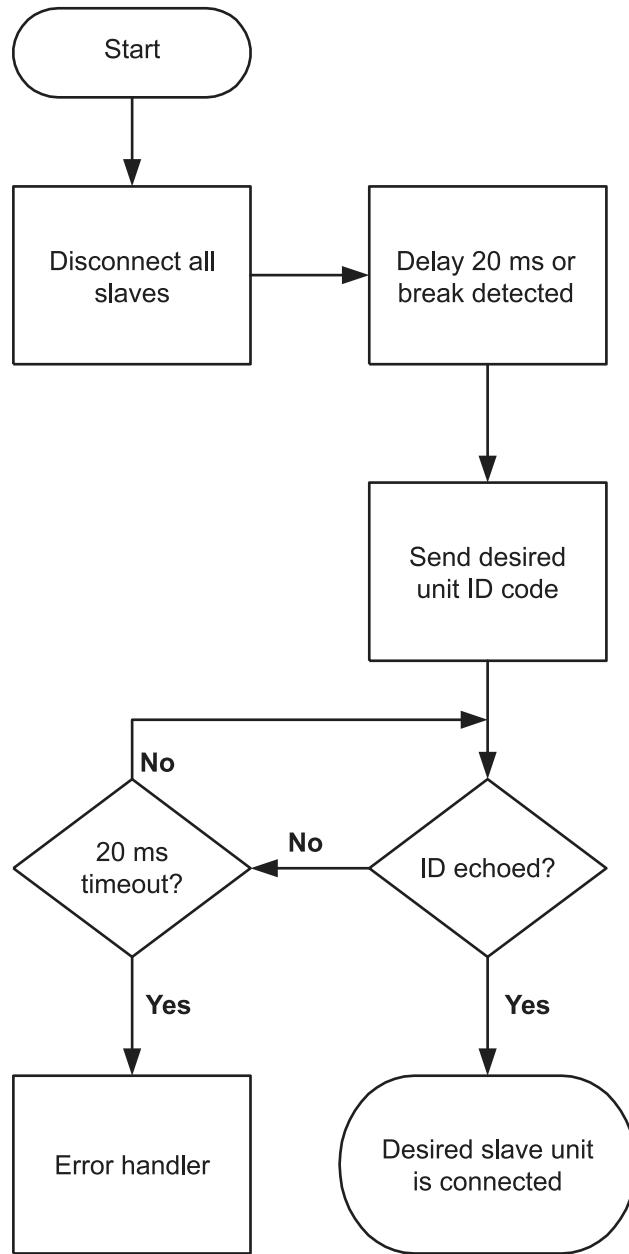
- The slave instrument that recognizes the binary name as its own connects its transmitter to the slave data channel and echoes its binary name to the master.

  The selected slave instrument must respond within 20 milliseconds. If it does not, the master assumes that the desired slave is unavailable.

  Any slave instrument that does not recognize its name remains disconnected.

- After the slave instrument is connected, the master instrument may send an immediate or a buffered command as described on pages 5-2 and 5-4.

  The selected instrument remains active until it receives any disconnect code or the binary name of a different slave instrument.

Disconnect/Connect Sequence

```
       ┌──────────┐
       │   Start  │
       └────┬─────┘
            │
            ▼
  ┌───────────────┐      ┌───────────────┐
  │ Disconnect all │────▶│ Delay 20 ms or │
  │    slaves      │      │ break detected │
  └───────────────┘      └───────┬───────┘
                                 │
                                 ▼
                         ┌───────────────┐
                         │  Send desired  │
                         │  unit ID code  │
                         └───────┬───────┘
                                 │
         No                      ▼
      ┌──────◇          No     ◇─────────
      │   20 ms  ◀────────────  ID echoed?
      ◇ timeout? ◇             ◇─────────
         │                          │
         │ Yes                      │ Yes
         ▼                          ▼
  ┌───────────────┐        ┌───────────────┐
  │ Error handler │        │ Desired slave unit│
  └───────────────┘        │  is connected  │
                           └───────────────┘
```

Master GSIOC Disconnect/Connect Sequence

Command Types 5

A computer using the Gilson GSIOC device driver can issue two types of GSIOC commands to a peripheral instrument: immediate commands and buffered commands.

Several device drivers that handle the low-level protocols described below are included with Gilson's 706 Device Driver Software.

Immediate Command Protocol

Immediate commands request status reports from a slave instrument. For instance:

- what kind of machine are you?
- what is your current operating mode?
- what are you doing now?
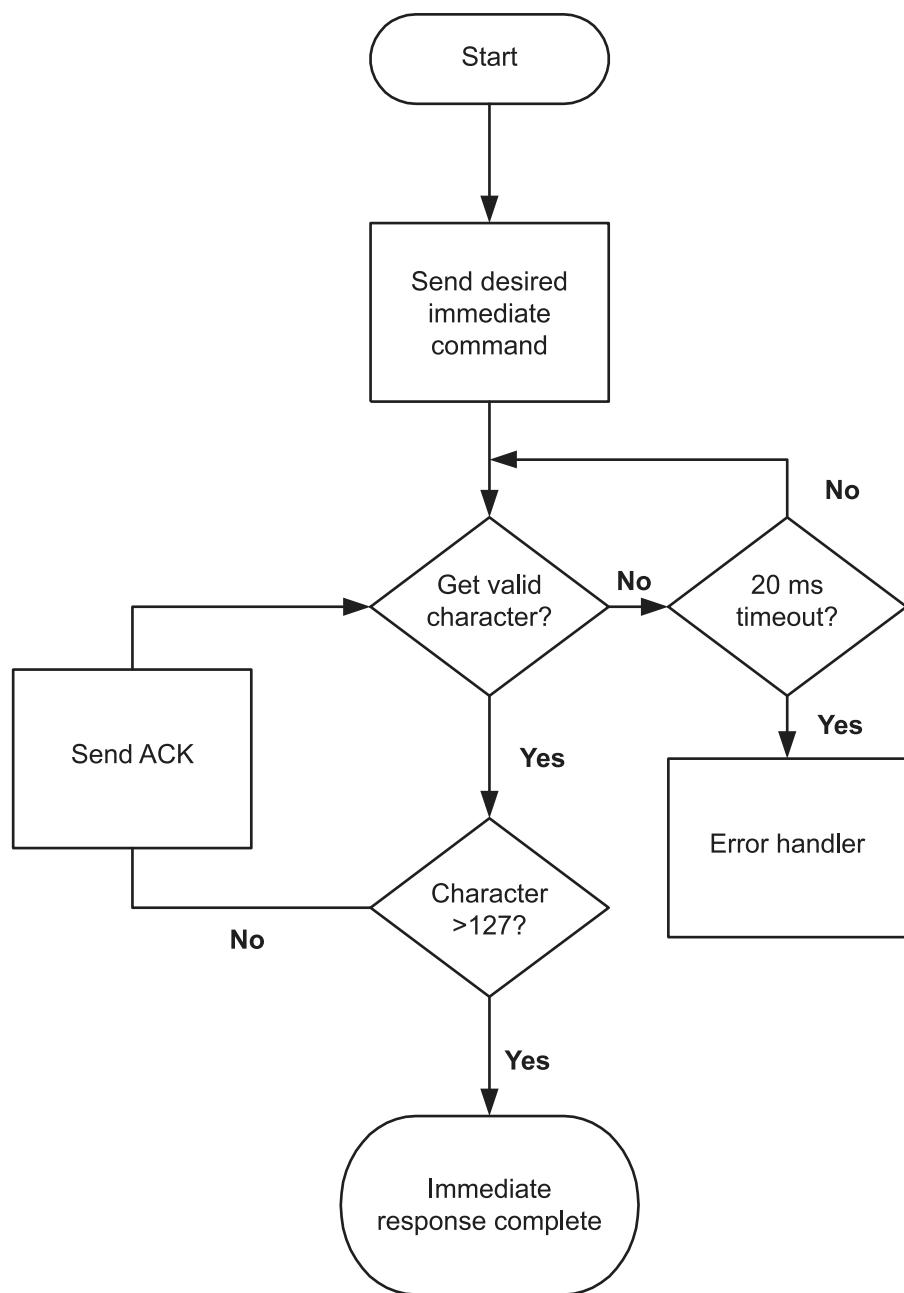
When a master instrument issues an immediate command to a designated slave, the slave immediately responds to the immediate (high-priority) command.

Immediate commands are always in the form of a single character.

After a slave instrument receives an immediate command, it answers the request with the first character of its response. The master checks the ASCII value of the character. If the character's value is less than 128, it responds to the slave with an ACK character (06 hexadecimal). This exchange continues until the slave sends the last character of the response. To indicate that the last character is being sent, the slave adds 128 (80 hexadecimal) to the character's value.

In response to an unrecognized immediate command, a slave responds with a pound sign (#), a value of 23 hexadecimal, and adds 128 (80 hexadecimal).

You can find a list of valid immediate commands for each slave instrument in its *User's Guide*.

```
                        ┌─────────────┐
                        │    Start    │
                        └──────┬──────┘
                               │
                               ▼
                        ┌─────────────┐
                        │ Send desired│
                        │  immediate  │
                        │   command   │
                        └──────┬──────┘
                               │                            No
                               ▼
                          ◇ Get valid ◇   No    ◇ 20 ms ◇
          ┌──────────────►◇ character?◇───────►◇ timeout?◇
          │               ◇           ◇        ◇          ◇
     ┌────┴─────┐              │ Yes                 │ Yes
     │ Send ACK │              ▼                     ▼
     │          │         ◇ Character ◇        ┌───────────┐
     └────┬─────┘         ◇   >127?   ◇        │   Error   │
          │    No         ◇           ◇        │  handler  │
          └───────────────◇           ◇        └───────────┘
                               │ Yes
                               ▼
                        ┌─────────────┐
                        │  Immediate  │
                        │  response   │
                        │  complete   │
                        └─────────────┘
```

Master GSIOC Immediate Command Protocol

Buffered Command Protocol

Buffered commands send instructions to a slave instrument. For instance:

- close a contact
- change the mode
- write on the display
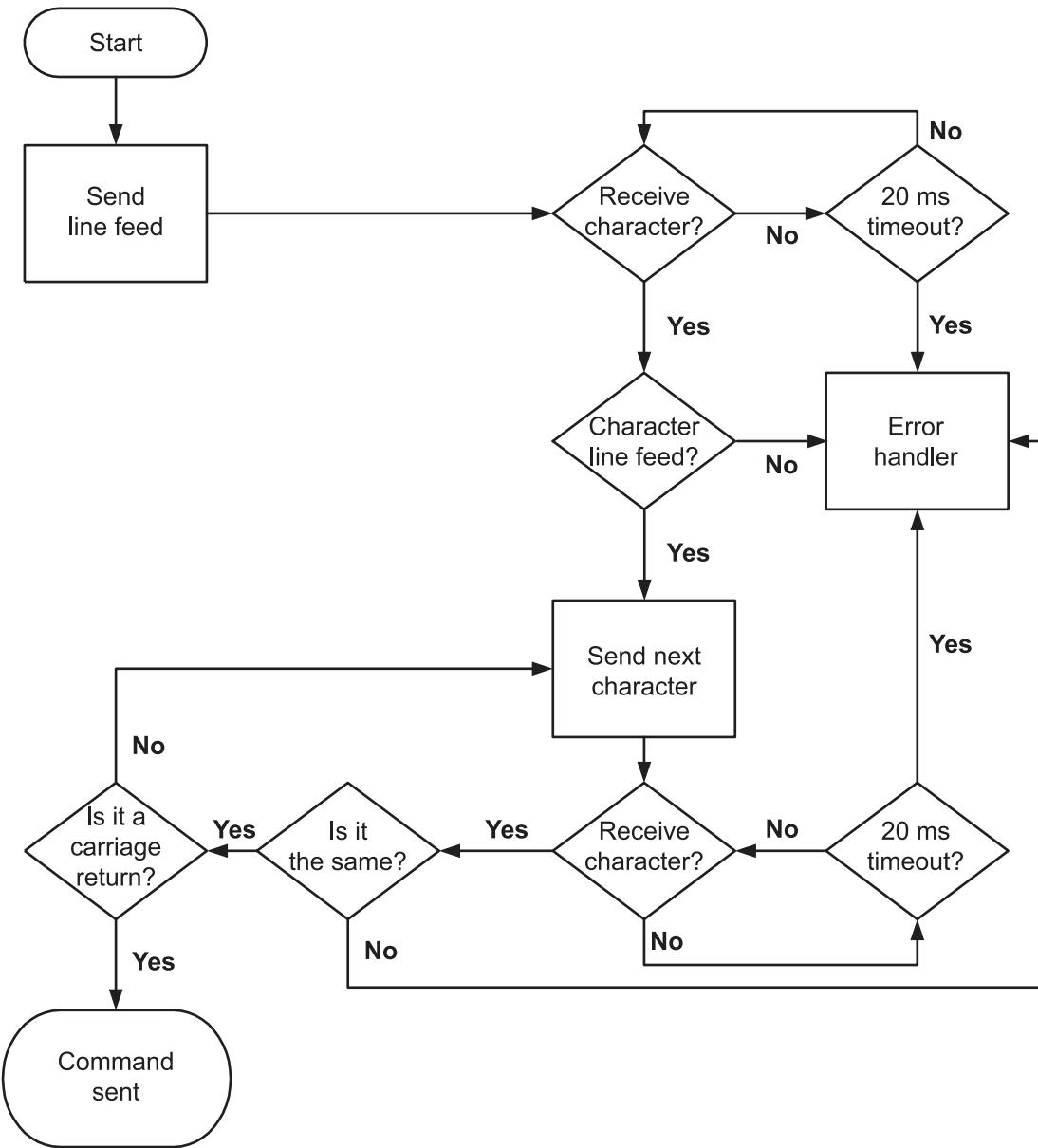
A buffered command is defined as a command string of ASCII characters preceded by a line feed (ØA hexadecimal) and followed by a carriage return (ØD hexadecimal).

After the master instrument selects a slave instrument (as described on page 4-2), it begins the buffered command protocol with a single line feed character.

If the slave is ready to accept a buffered command, it echoes the line feed to the master. The master then sends each subsequent character in the ASCII command string. As each character is received by the slave, it is echoed to the master for confirmation. When the master sends a carriage return character, the slave knows that the complete command has been sent.

If the slave is busy performing a buffered command when the master begins another buffered command, it responds instead with a # sign (23 hexadecimal). The master can continue to send the line feed character until the slave responds with a line feed character. At that time, the rest of the ASCII command string is sent.

You can find a list of valid buffered commands for each slave instrument in its *User's Guide*.

GSIOC Buffered Command Protocol