MANNESMANN
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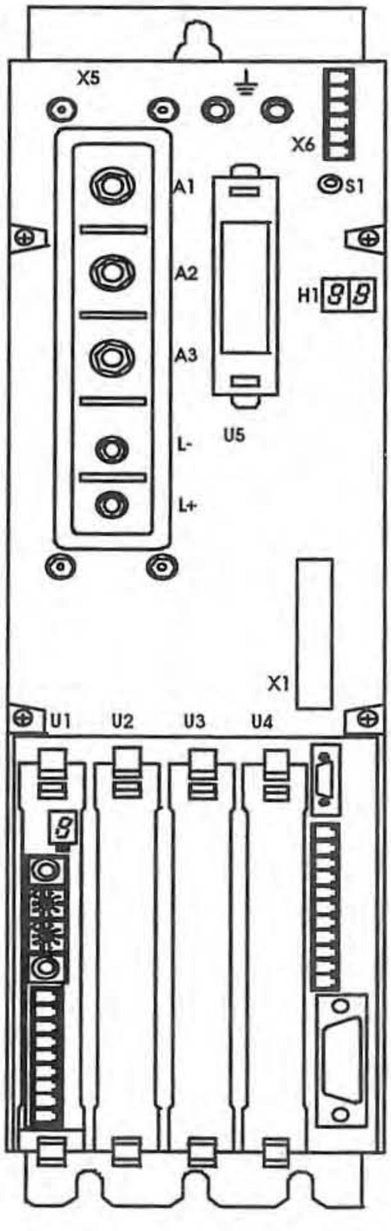
Indramat

INDRAMAT
DDS 2.1 DIGITAL SERVO DRIVE
USER'S MANUAL



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FOREWORD

Special Notations:

Special notations are used in this manual to assist the reader in identifying unique conditions or information that is important. Three categories of notations are listed below in ascending order of importance.

Note: *A NOTE is a tip, suggestion or emphasized procedure for operating the equipment.*

Caution: *A CAUTION appears when a condition exists which could cause operating faults or damage to the equipment.*

Warning: *WARNING statements identify conditions which could cause bodily harm and/or severe damage to the equipment if the operator is not careful operating the equipment. A WARNING typically describes the potential hazard, its possible effect, and measures that must be taken to avoid the hazard.*

Please *NOTE* that due to variations found in the operating conditions of certain applications and their working environments, the notations in this manual cannot identify all potential problems or hazards. Caution and discretion must always be used in operating machinery,especially when using electrical power. Equipment should only be installed and operated by trained personnel.

☛ *Repair and Training services are available from* **REXROTH INDRAMAT.**

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RECORD OF REVISIONS

Revision Level	Date	Description of Change
A	1/93	Preliminary Release
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CHAPTER 1. INTRODUCTION

The DDS 2.1 Intelligent Digital Servo Drive was developed using the most current state of the art technology available. The DDS 2.1 is a cost effective drive which responds superbly to the demanding requirements of today's automated factories.

The philosophy behind Indramats digital drive development was to build a digital drive that would perform at least as well as an analog drive. In addition, this drive must be easy to install and use, as demonstrated by Indramats "SysteMate" philosophy in the past. The basic challenge was to develop a drive which complied with three main objectives:

1) Real time processing with high update rates for the velocity loop was needed.

2) A high resolution feedback was needed to compete with a real time tachometer.

3) A standard digital interface was required which could perform well over closed control loops.

Indramat has accomplished these three objectives in the DDS 2.1. This drive uses a digital signal processor for the real time processing. This allows the DDS 2.1 to update its velocity loop, as well as a position loop, every 250µsec. Secondly, after over five years of research and development, Indramat now provides a state of the art feedback which enables the drive to measure position with a resolution of 1/4,000,000 of a revolution at speeds up to 6000 RPM. Finally, the DDS 2.1 uses a high performance digital interface called the SERCOS Interface, which was developed by several companies and is on its way to becoming an international standard.

The result of these efforts is a DDS 2.1 Digital AC Servo Drive which out performs the best analog drives on the market today. In addition it brings all the other attractive features of digital drives to market, such as digital parameter adjustments and more advanced diagnostics. Finally, the price is competitive with that of comparable analog drives.

1.1. System Description

An Indramat digital drive system consists of a modular DDS 2.1 Digital AC Servo Drive with a program module and a corresponding interface card plugged into the first slot. There are numerous configurations available with the use of different plug in modules to accommodate most applications. This allows more flexibility and customization of the DDS 2.1 Drive. (See Figure 1.1 DDS 2.1 Front Face.)

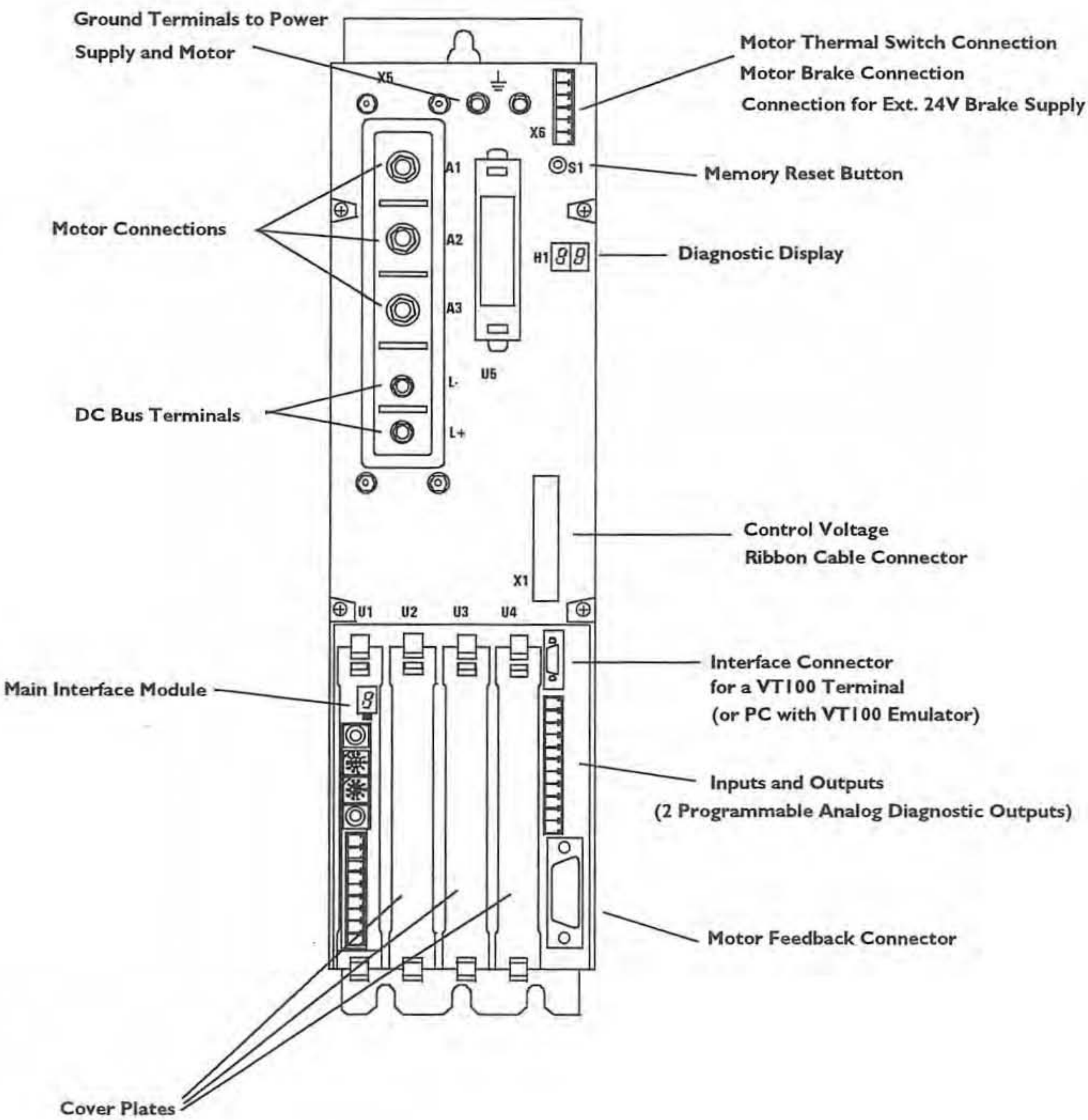


Figure 1.1 DDS 2.1 Front Face

On the front of the DDS 2.1, there is a 2 digit, 7-segment display which allows the user to quickly determine the status of the drive. This display communicates normal drive conditions as well as error codes. These are described in more detail in Chapter 6 of this manual.

Two outputs exist for analog monitoring of signals. These can be connected to an oscilloscope and the signals appearing on these outputs may be selected via the RS232 interface or SERCOS Interface.

An MDD series digital motor from Indramat is used with a Digital Servo Feedback, (DSF), mounted on the back. This feedback contains memory which stores all motor specific data. This data is then sent to the DDS 2.1 via the feedback cable and the drive automatically sets up its operating characteristics based on the motor type during powerup. There is also a multi-turn absolute DSF feedback available, which mechanically stores position over 4096 turns of the motor shaft.

The DDS 2.1 can be configured with most of the Indramat power supplies with a regulated 24V supply--an exception is the TVM 1.2. (Operating characteristics of the drive may vary between different supplies. See DDS 2.1 Selection Guide). This drive can also be mounted side by side with Indramats other modular AC servo and spindle drives.

1.2. Principles of Operation

Depending on the type of interface that is used, it is possible to run in one of four different closed loop operating modes. A closed torque loop mode alone can run in the DDS 2.1, where torque commands may be sent by an external control. A velocity loop can be closed around this internally in the drive as well, accepting velocity command values. The update time of this internal velocity loop is 250µsec. Either of these two modes may be run via the SERCOS Interface or the Analog Interface.

A third operating mode in which an internal position loop may be closed around the velocity and torque loops is possible when using the SERCOS Interface option. The update of this position loop is also done in 250µsec intervals. With this high speed internal position loop, system performance can be greatly improved. Typical update times when closing a position loop over an interface is 1 to 2 msec. When operating in position loop mode via SERCOS, the drive has the capability to perform a homing function.

The forth operating mode, also available via the SERCOS Interface, is called Single Axis Mode, (SAM). In this mode, the user defines a ramp, velocity and final position. When a go command is issued, this profile is executed independently by the axis.

When operating in the Analog Mode, all communications for parameter adjustments and diagnostics are done via the RS232 port. This port requires communication to a VT100 terminal, or terminal emulation program running on a PC. Menu driven screens guide the user through scaling adjustments, tuning, feedback setup, and other parameter adjustments. The entire user interface is contained in the DDS 2.1. No additional software, (other than terminal emulation software), is necessary.

The DDS 2.1 also contains an oscilloscope function that can store all signals in the drive. This allows velocity and position sampling at the drives update rate of 250µsec. Up to 2000 samples can be taken at one time, then transmitted via the SERCOS Interface. This function contains all features that would be found in a typical digital storage scope. The main advantage of an internal oscilloscope is that the same signals that the drive is processing can be captured and analyzed, noise free. In addition, greater accuracy can be achieved in setting trigger points based on any signal available in the drive.

There are additional plug in cards available for second position feedback inputs. Either analog or digital feedback input signals can be configured. When using SERCOS, both motor feedback data and external feedback data can be transmitted to, and used in a control.

CHAPTER 2. SERCOS INTERFACE

2

This chapter contains information on the SERCOS Interface specification as it applies to the DDS 2.1. If you have a DDS 2.1 which does not have a SERCOS Interface card, (DSS 1.1) plugged in the first card slot, U1, then your drive is not configured to use the SERCOS Interface, in which case this chapter may be skipped over.

2.1. SERCOS Interface Specifications

The SERCOS Interface Specification was developed by several companies with the intention of standardizing on an interface between controls and digital drives. SERCOS, which stands for SErial Realtime COmmunication System, uses fiber optics as its transmission medium. Indramat developed one of the first digital servo drives which incorporated SERCOS in its DDS 1.1 Digital Drive product. The DDS 2.1 Digital Drive is now the second generation of Indramat's family of SERCOS products. The topology for SERCOS as it applies to the DDS 2.1 is shown in figure 2-1.

Each DDS 2.1 on the SERCOS ring must be set to a unique address from 1 to 99. For more information on setting the SERCOS address, see section 2.1.2.

Digital information is communicated on a SERCOS ring between the Master, which is defined as the SERCOS communication section of the motion control unit, and the Slave of each DDS 2.1, where the Slave is the SERCOS communication section of the drive. In the case of the DDS 2.1, the Slave is configured on the DSS 1.1 SERCOS Interface Module. Note that all data transfers take place between the Master and a Slave. There is no direct communication between Slaves. This is necessary to maintain strict timing requirements within the system. When the data is received by a Slave and accepted, it is repeated back to the ring for the next Slave.

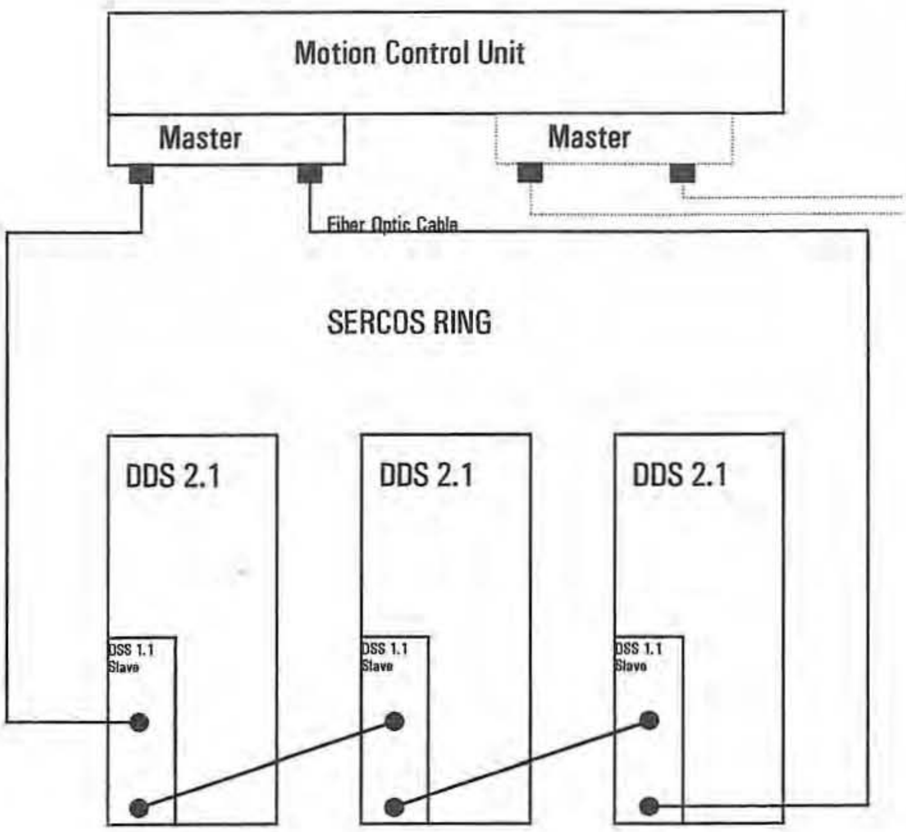


Figure 2.1 SERCOS DDS 2.1 Topology

2.1.1. Data Blocks

All data in a SERCOS system is stored or configured in a block format. Figure 2.1 SERCOS DDS 2.1 Topology shows the data block structure. Each data block is identified by an ID Number, (IDN). For example, IDN S-0-0100 represents Velocity Loop Proportional Gain. This data block also contains the ASCII representation of the name and units of the data, as well as minimum and maximum values that may be entered. An attribute field defines how the data is interpreted between the operator and the machine and also the type of data to be entered. Finally, the last field contains the actual data itself. In the example noted above, this data would be the proportional gain that was originally selected by the drive or the value entered by the programmer. Data blocks can vary greatly in size, depending on their data content.

Element 1	**ID Number**	**Data Status**
Element 2	**Parameter Name (ASCII)**	
Element 3	**Attribute**	
Element 4	**Units to Display (ASCII)**	
Element 5	**Minimum Input Value**	
Element 6	**Maximum Input Value**	
Element 7	**Operation Data**	

Figure 2.2 SERCOS Data Block Structure

The total number of IDN's, (or data blocks) which the SERCOS Interface Specification allows is 65,536. 32,768 of these IDN's are reserved for SERCOS defined data. The example above is of this type and is identified by the "S" in the ID Number. The other 32,768 are reserved for product specific data, which a drive or control manufacturer may use for their own proprietary features. This data is identified by a "P" in the ID Number for Product Specific. Finally, each of these groups of 32,768 IDN's are divided into 8 parameter sets of 4096 IDN's each. This is the maximum number of IDN's that are allowed for SERCOS or Product Specific data. These parameter sets can then be used in applications where several data values need to be changed. These values can be loaded in an inactive state while another parameter set is active. When the data is complete, the parameter sets can be switched. Examples of applications that would use this feature are electronic gearing, where it is desired to have several gear ratios change simultaneously, and also gain scheduling.

2.1.2. Data Communications

The Master begins a communication cycle by transmitting a Master Synchronization Telegram, (MST),to all connected drives. The structure of this telegram is shown in the figure below.

BOF	ADR	Communication Phase	FCS	EOF

Figure 2.3 Structure of Master Synchronization Telegram

All other data that is communicated in the rest of the cycle is either placed on the ring or read from the ring at precise time intervals measured from the end of the MST. Each drive continuously synchronizes its own internal clock directly off the data received by the Master. All data received by the drives become active at a defined time interval after the MST, forcing all drives to act on their data simultaneously. The figure below shows a typical cycle.

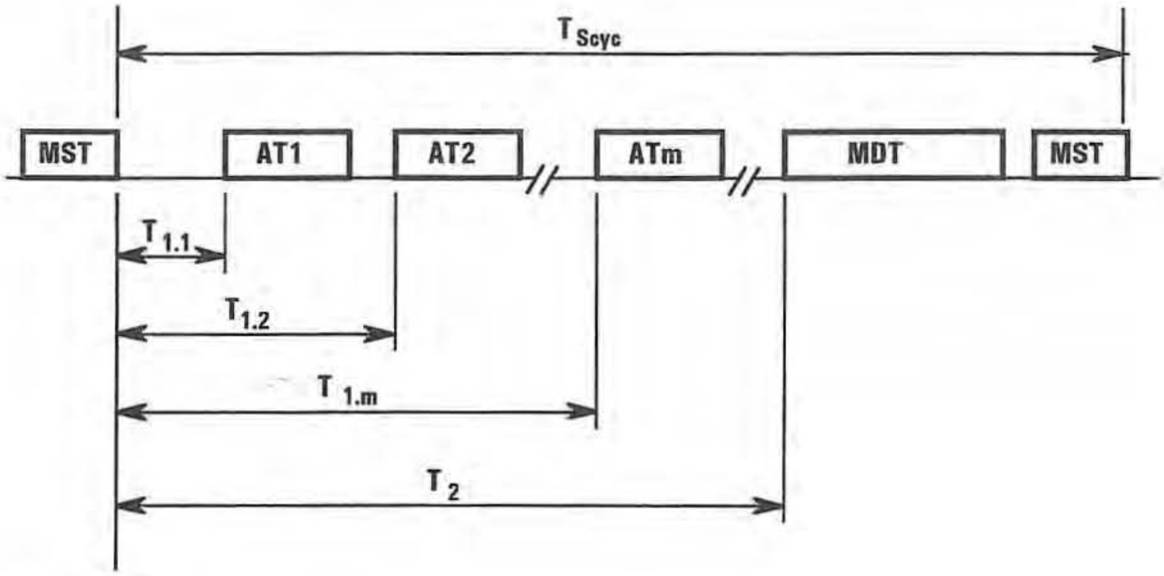


Figure 2.4 SERCOS Cycle

All data to be acted upon by the drive is communicated from the Master via a Master Data Telegram, (MDT). One Master Data Telegram is sent out per SERCOS communication cycle. Each MDT contains data for all drives, and it is the duty of each Slave to extract the pertinent data from the MDT for its respective drive. The data for a particular drive is designated as a byte position within the MDT, (see IDN S-0-0009). These byte positions are the same every cycle and are determined during an initialization process when SERCOS is first brought up. The structure of the MDT is shown in Figure 2.5 Master Data Telegram, (MDT), Structure.

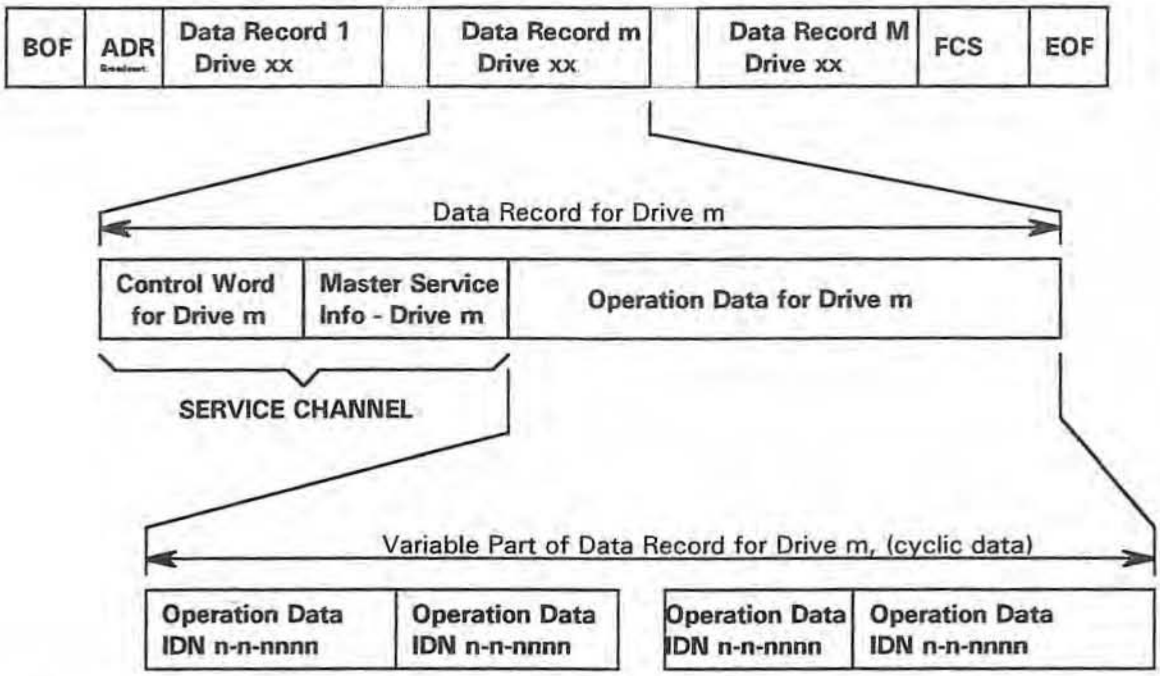


Figure 2.5 Master Data Telegram, (MDT), Structure

The operation data field of the MDT for a particular drives' data record contains data that is to be sent to the drive on a cyclic basis. An example of this would be a velocity command value or position command value. This type of data must be updated continuously and in a timely fashion in order to maintain the integrity of a closed loop control system. This data is considered to be time critical. Non-time critical data can be placed in the Master Service Info field, which is 2 bytes wide. Data that is longer than 2 bytes would require several SERCOS cycles to transmit.

Finally, there is a Control Word in each drive data record that contains hand shaking signals for control of the non-time critical data transmissions, real time bit control and also to initiate special functions or procedures in the DDS. The Control Word also communicates the sequential powering up and enabling of each drive.

All data that is to be sent from the drive back to the control unit is communicated via an Amplifier Telegram, or AT. Each drive sends its own AT back to the control unit every cycle and there is a specified time slot designated for each drives AT. The operation data field of the AT for a particular drive contains data that is to be sent to the control unit on a cyclic basis. An example of this would be a velocity feedback value or position feedback value. Like the MDT, this type of data must be updated continuously and in a timely fashion in order to maintain the integrity of a closed loop control system. This data is considered to be time critical. Non-time critical data can be placed in the Drive Service Info field, which is 2 bytes wide. Data that is longer than 2 bytes would require several SERCOS cycles to transmit. The structure of the AT is shown in Figure 2.6 Amplifier Telegram, (AT), Structure.

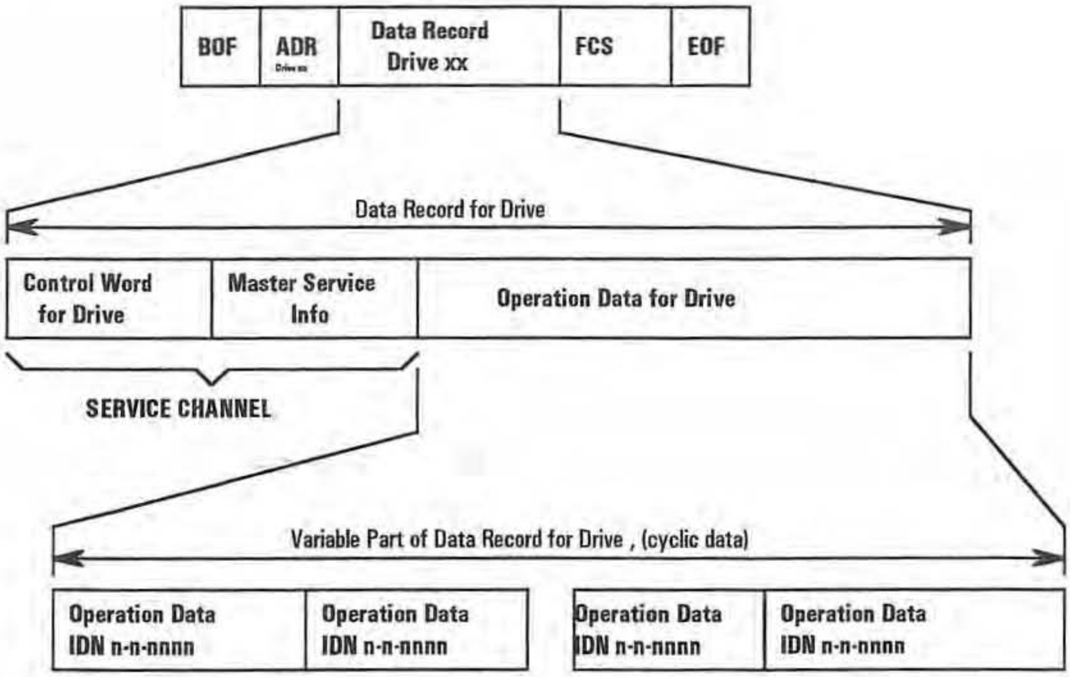


Figure 2.6 Amplifier Telegram, (AT), Structure

Analogous to the Masters Control Word, there is a Status Word sent out by each drive in the AT. As with the Control Word, the Status Word contains hand shaking signals for control of the non-time critical data transmissions. Real time status, as well as status of general operating conditions and states, including drive diagnostics is also placed in this word.

Telegram Type

Before the system can be started some setup is required. One parameter that must be loaded in every drive is the Telegram Type Parameter, (S-0-0015). This parameter determines the type of data that will be communicated cyclically between the master and the drive. There are 6 predefined telegram configurations that may be selected, or a custom configuration can be assembled.

When a custom telegram is selected, the ID Numbers of the data to be communicated cyclically by a particular drive must be placed in the AT and MDT configuration lists, (IDN S-0-0016 and IDN

S-0-0024). Only data that is found in the lists of configurable data of the AT and MDT, (IDN S-0-0187 and IDN S-0-0188), may be placed in these configuration lists.

Initialization

The most critical feature of the SERCOS Interface is its timing and synchronization capability. When a SERCOS system is first powered up, the devices on the SERCOS ring are unable to communicate in normal operation as defined by the SERCOS Interface Specification. In order for it to operate in this normal mode, each device must first be initialized so that all time slots are appointed and all data to be transmitted cyclically is assigned for all telegrams. This initialization process is comprised of five communication phases which must be executed sequentially.

Communication Phase 0 - Ring Closure

This is the first and most fundamental communication phase and its purpose is to check that the SERCOS ring has been closed. The control unit sends out a sequence of MST's on the transmitter of the Master until it counts 10 consecutive MST's returned back on its receiver. Once this has occurred, it is verified that the ring is closed properly, and the Master switches all devices to Communication Phase 1.

Communication Phase 1 - Device Identification

In this phase, the control unit checks all devices on the ring to confirm that they are in their correct physical locations and that all addresses are set correctly. Once this has been confirmed, the Master switched all devices to Communication Phase 2.

Communication Phase 2 - Timing Parameterization

In this phase, the control unit first runs several timing routines to determine the response of each device. After this is determined, the control unit calculates all communication timing parameters and loads the correct values to each drive. Communication during this phase takes place between the Master and each drive, where only one drive at a time may be communicated to per cycle. All drives must then report back to the control unit when all timing parameters are satisfied. The control unit then switches the system to Communication Phase 3.

Communication Phase 3 - General Parameterization

Now that all timing parameters are in place, the control unit is able to communicate more efficiently to all the drives, every cycle. All the remaining parameters are now communicated to the drives via the Service Channel of the MDT. In this phase, the cyclic data channels of the MDT and AT's exist, but are not used. After all application data has been loaded and is considered valid and complete by every device on the ring, the control unit switches the system to Communication Phase 4.

Communication Phase 4 - Normal Operation

In this final phase, the communication between the Master and every drive is fully operational. Once the devices are enabled, they may run high performance closed loops serially across this SERCOS communication link.

If any error occurs during the initialization process, a drive may only descend to Communication Phase 0. By sequencing from Phase 0 to Phase 2, it is then possible to determine the error that took place. It is only possible to ascend communication phases sequentially.

Diagnostics

There are three levels of diagnostics in the SERCOS Interface specification. These three levels are designed to handle different situations more effectively.

Class 1 Diagnostics - Shutdown Errors

Class 1 Diagnostics, or Shutdown Errors indicates that there is a fault in the drive and that the drive is in the process of shutting itself down. The drive shuts itself down by decelerating to zero speed and then removing torque from the motor by disabling the power section of the drive. In addition, the drive returns to Communication Phase 0, and, depending on the control unit, may progress to Communication Phase 2 so that the error can be further diagnosed.

When this type of error occurs, the drive immediately notifies the master of its shutdown status via the Class 1 Diagnostic bit in the Status Word of the AT. In addition, there is an IDN that contains a description of the error which occurred called Class 1 Diagnostics, IDN S-0-0011. The master may display a diagnostic message indicating the fault that has caused the shutdown to the user.

This shutdown status can only be reset after all shutdown fault conditions have been corrected. Once this has been done, the master may reset this status with the "Reset Class 1 Diagnostics" procedure command, IDN S-0-0099.

Class 2 Diagnostics - Warnings

Warning conditions can occur in the DDS 2.1, which, if not corrected, may cause a Class 1 Diagnostic, Shutdown Error. When a warning condition occurs in the drive, the Class 2 Diagnostic bit in the status word of the AT is immediately set. Also, if the warning condition disappears, this bit is set. In other words, whenever the warning status of the drive changes, it sets the Class 2 Diagnostic bit. This bit is reset whenever the Master reads the Class 2 Diagnostic - Warning, IDN S-0-0012. This assures that the Master has been warned.

Class 3 Diagnostics - Operational Status

Class 3 Diagnostics or Operational Status conditions may occur in the DDS 2.1 during normal operation. This is not a fault condition. This enables the drive to quickly communicate to the Master when certain events have occurred, such as when the commanded speed has been reached, when an axis is in position, etc. Whenever the operational status of the drive changes, as with Class 2 Diagnostics, it sets the Class 2 Diagnostic bit. This bit is reset whenever the Master reads the Class 3 Diagnostic - Operational Status, IDN S-0-0013. This assures that the Master has been informed.

Scaling

All position data, velocity data, torque-force data and acceleration data can be scaled within the SERCOS Interface. This is important to efficiently transfer data between the control unit and the drives with the correct scaling defined. The scaling options parameters are used to define how scaling will be done for each type of data. These parameters are as follows:

S-0-0076 Scaling Options for Position Data
S-0-0044 Scaling Options for Velocity Data
S-0-0086 Scaling Options for Torque-Force Data
S-0-0160 Scaling Options for Acceleration Data

Polarity for position, velocity and torque can also be defined by the following parameters:

S-0-0055 Position Polarity Parameter
S-0-0043 Velocity Polarity Parameter
S-0-0085 Torque Polarity Parameter

Real Time Bits

When the drive is performing some operation or procedure which requires the drive to react immediately to some event, the drive can notify the Master that the event has occurred and that it has already reacted via the real time bit.

One important use of the real time bits is a probing procedure. This is where several axes may be positioning a probe and slowly moving this probe into a machined part. The objective is to find the exact position of each of the axes when this probe touches the part. Since the probe is basically just a switch, when it touches the part, the switch is activated. This probe switch can be fed to each of the drives, so that when the probe is activated, each drive can immediately capture its own position at the point of contact. The real time bits in the AT Status Words are immediately set, notifying the Master that the probe made contact and the positions are latched. The Master may then proceed to query each drive to obtain the positions for processing.

Another similar application would be registration. This is where a registration mark on material, such as on a roll of printed packaging material, is encountered between each successive pattern. This enables the control to make adjustments to the positioning of the pattern of each feed.

2.1.3. Setting the Address on the DDS 2.1

In order for the system to successfully execute SERCOS Communication Phase 1 of the initialization sequence, the addresses of the drives must be correctly entered. No two drives may have the same address when connected to a common SERCOS ring. The drive addresses are selected on the DSS 1.1, SERCOS Interface Card. There are two small rotary selector switches on the front of this card. The high address is set with the switch S3 and the low address is set with switch S2. (See also section 4.3, DSS 1.1 SERCOS Interface Card Installation.)

2.2. SERCOS Specific Parameters

S-0-0001 Control Unit Cycle Time, (t_{Ncyc})

The Control Unit Cycle Time defines the cyclic intervals during which the control unit makes new command values available. The Control Unit Cycle Time must be an integer multiple of the SERCOS cycle time. ($t_{Ncyc} = t_{Scyc} * j$, $j = 1,2,3.....$). This value is calculated and loaded by the control unit during Communication Phase 2 and becomes active in Communication Phase 3 of Initialization.

Data Length: 2 bytes
Min. Input: 250µsec
Max. Input: 65,000µsec
Scaling: 1µsec
Units: µsec
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

S-0-0002 SERCOS Cycle Time, (t_{Scyc})

The cycle time of the interface defines the intervals during which the cyclic data are transferred. The interface cycle times that would be valid for the DDS 2.1 are 250 µsec or any integer multiple of 250 µsec. This value is loaded by the master during Communication Phase 2 and becomes active in Communication Phase 3 of Initialization.

Data Length: 2 bytes
Min. Input: 250µsec
Max. Input: 65,000µsec
Scaling: 1µsec
Units: µsec
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

S-0-0003 Minimum AT Transmit Starting Time, (t_{1min})

Indicates the time requirement off the drive between the end of the reception of the MST and the start of transmission of the AT. This time interval, required by the drive, depends on the selected telegram type, (see section 2.3). The time t_{1min} is read by the Master during Communication Phase 2 in order to calculate the AT Transmission Starting Time, t_1 (IDN S-0-0006).

Data Length: 2 bytes
Scaling: 1µsec
Units: µsec
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

S-0-0004 Transmit to Receive Transition Time, (t_{ATMT})

The time required by the DDS 2.1 to switch from transmitting the AT to receiving the MDT. This parameter is read by the Master during Communication Phase 2 in order to correctly calculate the time t_2, MDT Transmit Starting Time, IDN 00089.

Data Length: 2 bytes
Scaling: 1µsec
Units: µsec
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0005 Minimum Feedback Acquisition Time, (t_5)

The time required by the drive, between the start of the feedback acquisition and the end of the next MST. This time is set to a value that makes it possible for the drive to place the feedback value in the next AT. The Master reads this value during Communication Phase 2 in order to calculate the Feedback Acquisition Time, IDN S-0-0007.

Data Length: 2 bytes
Scaling: 1µsec
Units: µsec
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0006 AT Transmission Starting Time, (t_1)

The AT Transmission Starting Time determines the time after the MST in which the Master will send it's AT during Communication Phases 3 and 4. This value is loaded by the master during Communication Phase 2 and becomes active in Communication Phase 3 of Initialization. ($t_1 > t_{1min}$).

Data Length: 2 bytes
Min. Input: 1µsec
Max. Input: 65000µsec
Scaling: 1µsec
Units: µsec
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

S-0-0007 Feedback Acquisition Starting Time, (t_4)

The Feedback Acquisition Starting Time is the time after the MST at which the drives capture the feedback data. The time in each drive is set so that the acquisition is synchronized so that all drives capture their feedback data simultaneously. $t_4 \leq t_{Scyc} - t_5$.

Data Length: 2 bytes
Min. Input: 1µsec
Max. Input: 65000µsec
Scaling: 1µsec
Units: µsec

Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

S-0-0008 Command Valid Time, (t_3)

This parameter determines the time after the MST at which the drive is allowed to access new command values. The time is set in each drive so that the Command Valid time occurs simultaneously in all the drives. This maintains system synchronization. This parameter is activated in Communication Phase 3.

Data Length: 2 bytes
Min. Input: 0µsec
Max. Input: t_{Scyc}
Scaling: 1µsec
Units: µsec
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

S-0-0009 Beginning Address in MDT

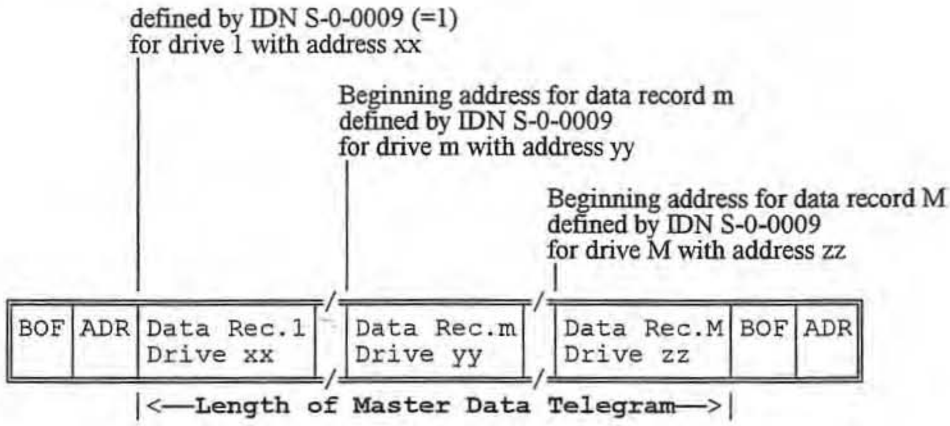
The beginning address of a data record of the drive within the MDT, expressed as a byte position. It starts with $01 for the initial data byte after the address field within the MDT. Every drive is informed by the master during Communication Phase 2 where the beginning address of its respective data record will be located in the MDT. The beginning address in the MDT becomes active during Communication Phase 3 in the Master and Slave.

Data Length: 2 bytes
Min. Input: 1 (for only one drive)
Max. Input: 5061 (20 bytes/drive * 253 drives + 1)
Units: Hex Number
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

S-0-0010 Length of the MDT

The Length of the MDT, expressed in bytes, includes data records for all drives. Every drive is informed of the length of the MDT by the Master during Communication Phase 2. This parameter becomes active in Communication Phase 3.

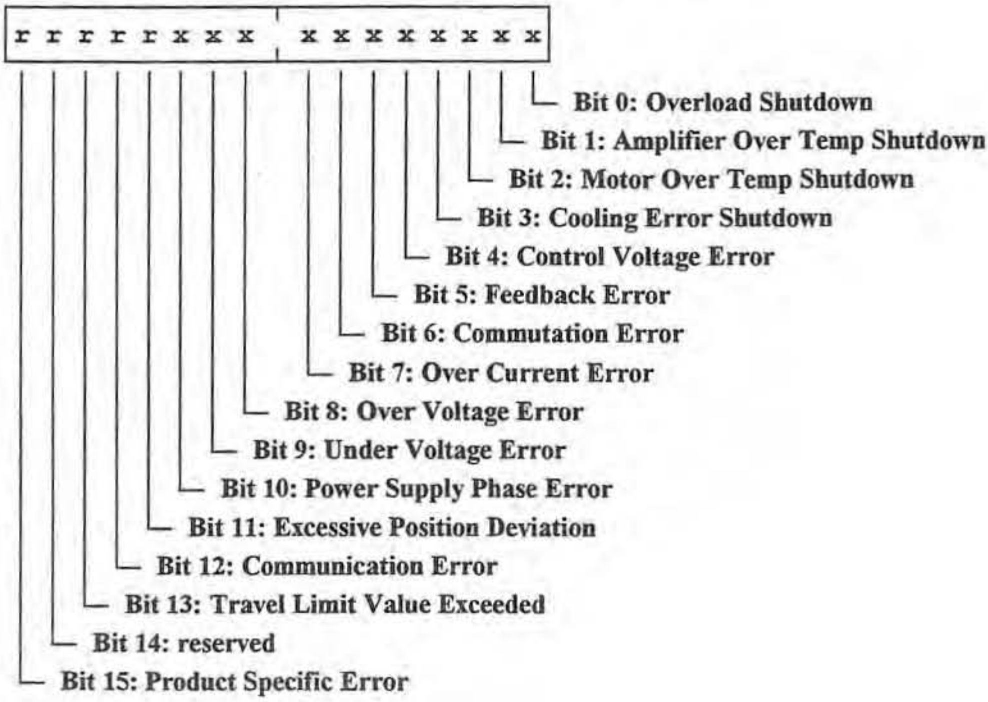
Data Length: 2 bytes
Min. Input: 1 (for only one drive)
Max. Input: 5061 (20 bytes/drive * 253 drives + 1)
Units: Hex Number
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2



S-0-0011 Class 1 Diagnostics

A Class 1 Diagnostic indicates a shutdown error or fatal error condition in the drive. When this condition exists, the drive decelerates in the best possible manner to zero speed, followed by the shutting down of the torque. At the same time, the drive signals the master of its shutdown by setting the Class 1 Diagnostic bit to "1" in the Drive Status Word. This bit is reset only after the condition which caused the shutdown is cleared and the command "Reset Class 1 Diagnostics" is received by the drive via the service channel.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4, (Read Only)



Note: Bit = 0: No Error
Bit = 1: Error Exists

S-0-0012 Class 2 Diagnostics

A Class 2 Diagnostic indicates a shutdown warning. When a warning condition is either activated or canceled, the change bit for Class 2 Diagnostics in the Drive Status Word is set to "1". This bit is only reset after the Master reads the Class 2 Diagnostic to see what warning condition has changed.

There is a mask associated with Class 2 Diagnostics which can mask certain bits so that a change in that particular warning condition will not set the masked bit and therefore not set the Class 2 Diagnostic bit in the Drive Status Word.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4, (Read Only)

```
r r r r r x x x | x x x x x x x x
```

- **Bit 0: Overload Warning**
- **Bit 1: Amplifier Over Temp Warning**
- **Bit 2: Motor Over Temp Warning**
- **Bit 3: reserved**
- **Bit 4: reserved**
- **Bit 5: reserved**
- **Bit 6: reserved**
- **Bit 7: reserved**
- **Bit 8: reserved**
- **Bit 9: reserved**
- **Bit 10: reserved**
- **Bit 11: reserved**
- **Bit 12: reserved**
- **Bit 13: reserved**
- **Bit 14: reserved**
- **Bit 15: Product Specific Warning**

Note: Bit = 0: No Warning
Bit = 1: Warning Exists

S-0-0013 Class 3 Diagnostics

A Class 3 Diagnostic indicates an operating status. When an operating status condition is either activated or canceled, the change bit for Class 3 Diagnostics in the Drive Status Word is set to "1". This bit is only reset after the Master reads the Class 3 Diagnostic to see what operating status condition has changed.

There is a mask associated with Class 3 Diagnostics which can mask certain bits so that a change in that particular operating status condition will not set the masked bit and therefore not set the Class 3 Diagnostic bit in the Drive Status Word.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4, (Read Only)

`r r r r r x x x | x x x x x x x x`

- Bit 0: $n_{actual} = n_{command}$
- Bit 1: $|n_{actual}| = 0$
- Bit 2: $|n_{actual}| < |n_x|$
- Bit 3: $|T| \geq |T_x|$
- Bit 4: $|T| \geq |T_{limit}|$
- Bit 5: $|n_{command}| > |n_{limit}|$
- Bit 6: In position
- Bit 7: $|P| \geq |P_x|$
- Bit 8: Service Request
- Bit 9: reserved
- Bit 10: reserved
- Bit 11: reserved
- Bit 12: reserved
- Bit 13: reserved
- Bit 14: reserved
- Bit 15: Product Specific Operation Status

Note: Bit = 0: Condition does not exist
Bit = 1: Condition exists

S-0-0014 Interface Status

The Interface Status indicates whether a communication error has occurred. If an error has occurred, the Class 1 Diagnostics bit for communication error is set, and the error and the communication phase at the time of the error will be latched in this IDN. If no communication error exists, the present communication phase is designated by bits 0 to 2. The drive cancels a communication error and resets to "0" only if the error indicated by the interface status has been eliminated and upon receiving the command "Reset Class 1 Diagnostics" via the service channel.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4, (Read Only)

```
r r r r r x x x   x x x x x x x x
```

- **Bit 2-0: Communication Phase**
- **Bit 3: MST Failure** (Diag. Code 01, See pg 6- 5)
- **Bit 4: MDT Failure** (Diag. Code 02, See pg 6-5)
- **Bit 5: Invalid phase (phase > 4)** (Diag. Code 03, See pg 6-6)
- **Bit 6: Error while incrementing phase (proper sequence?)** (Diag. Code 04, See pg 6- 6)
- **Bit 7: Error while decrementing phase (not to phase 0)** (Diag. Code 05, See pg 6-6)
- **Bit 8: Phase incremented without ready message** (Diag. Code 06, See pg 6-7)
- **Bit 9: Switching to uninitialized operation mode** (Diag. Code 07, See pg 6-7)
- **Bit 10: 2 drives set to the same address in the ring** (Diag. Code 03, See pg 6-6)
- **Bit 11: reserved**
- **Bit 12: reserved**
- **Bit 13: reserved**
- **Bit 14: reserved**
- **Bit 15: reserved**

S-0-0015 Telegram Type Parameter

The telegram type parameter allows the ability to select between SERCOS defined telegrams and custom telegrams. The SERCOS defined telegrams determine which parameters will be transmitted cyclically in both the MDT and the AT. The SERCOS defined telegrams are considered more commonly used and therefore pre-defined by the SERCOS Interface Specification. If telegram configurations other than the ones provided are required, they can be called out by the Custom Telegram as shown below.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

Structure of IDN S-0-0015:

```
0 0 0 0 0 0 0 0 | 0 0 0 0 0 x x x
                            | | |
                            0 0 0 - SERCOS Defined Telegram 0
                            0 0 1 - SERCOS Defined Telegram 1
                            0 1 0 - SERCOS Defined Telegram 2
                            0 1 1 - SERCOS Defined Telegram 3
                            1 0 0 - SERCOS Defined Telegram 4
                            1 0 1 - SERCOS Defined Telegram 5
                            1 1 0 - SERCOS Defined Telegram 6
                            1 1 1 - Custom Telegram
```

SERCOS Defined Telegram 0 - Service Channel Communication Only

When set up with this telegram type, no data is configured for the operation data field. This means that no data is defined to be sent cyclically in the MDT or the AT. Only service channel data is sent in this configuration.

SERCOS Defined Telegram 1 - Torque Control

This pre configured telegram supports the torque loop control mode in the drive. The data for the MDT and the AT operation data fields are configured as follows:

MDT Data Field 1

Torque Command Value IDN S-0-0080

SERCOS Defined Telegram 1 has no AT Data Field.

SERCOS Defined Telegram 2 - Velocity Control in Drive

This preconfigured telegram supports the velocity loop control mode in the drive. Position feedback acquisition takes place in the control unit, therefore no position data needs to be transferred between the control unit and the drive. The data for the MDT and the AT operation data fields are configured as follows:

MDT Data Field 1

Velocity Command Value IDN S-0-0036

AT Data Field 1

Velocity Feedback Value IDN S-0-0040

2

SERCOS Defined Telegram 3 - Velocity Control w/Position Acquisition in Drive

This pre configured telegram supports the velocity loop control mode in the drive. Position feedback acquisition also takes place in the drive and is sent to the control unit via the AT. The data for the MDT and the AT operation data fields are configured as follows:

MDT Data Field 1

```
Velocity Command Value
IDN S-0-0036
```

AT Data Field 1

```
Position Feedback Value 1 or 2
IDN S-0-0051 or S-0-0053
```

SERCOS Defined Telegram 4 - Position Control in Drive

This pre configured telegram supports the position loop control mode in the drive. The data for the MDT and the AT operation data fields are configured as follows:

MDT Data Field 1

```
Position Command Value
IDN S-0-0047
```

AT Data Field 1

```
Position Feedback Value 1 or 2
IDN S-0-0051 or S-0-0053
```

SERCOS Defined Telegram 5 - Velocity and Position Control in Drive

This pre configured telegram supports both the velocity and position loop control mode in the drive. This allows the control unit to switch the drive between position loop control and velocity loop control modes on the fly. The data for the MDT and the AT operation data fields are configured as follows:

MDT Data Field 1	MDT Data Field 2
Position Command Value IDN S-0-0047	Velocity Command Value IDN S-0-0036

AT Data Field 1	AT Data Field 2
Position Feedback Value 1 or 2 IDN S-0-0051 or S-0-0053	Velocity Feedback Value IDN S-0-0040

SERCOS Defined Telegram 6 - Velocity Control in Drive

This preconfigured telegram supports the velocity loop control mode in the drive. Position feedback acquisition takes place in the control unit. This is similar to SERCOS Defined Telegram 2, except that no velocity feedback data is sent back to the control unit. This is useful for saving time in a SERCOS cycle. The data for the MDT and the AT operation data fields are configured as follows:

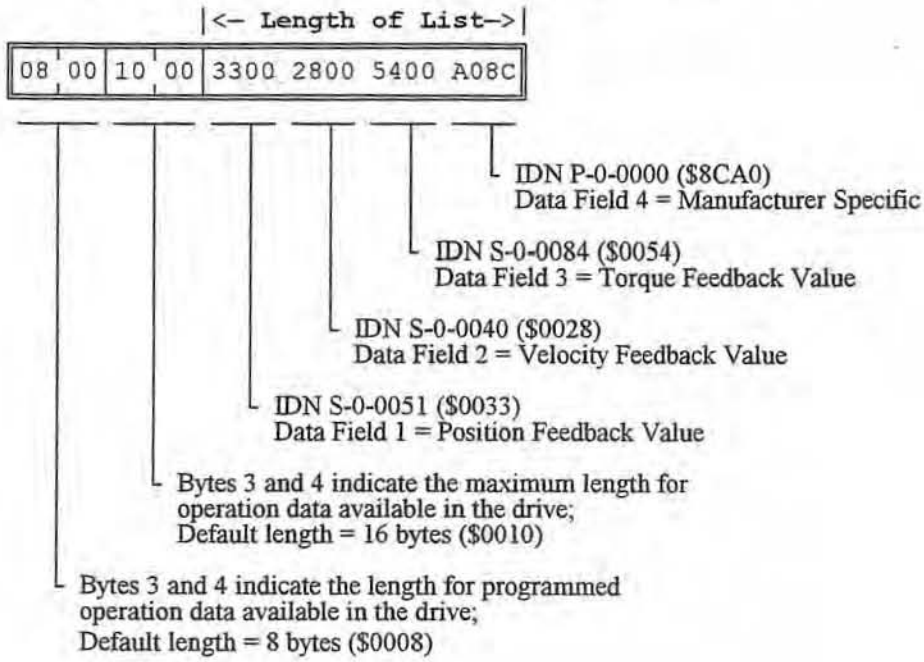
MDT Data Field 1
Velocity Command Value IDN S-0-0036

S-0-0016 Custom AT Configuration List

The ID Numbers that will be transmitted cyclically in the AT are placed in this configuration list. This parameter only needs to be supported if Custom Telegram is selected in IDN S-0-0015. Only ID Numbers that are present in the List of AT Configurable Data, IDN S-0-0187 are allowed to be added to this configuration list.

Data Length: Variable, (even number of bytes)
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2 (Write protected if Telegram Type, IDN S-0-0015 ≠ 0007h)

Example Structure of AT Custom Configuration List

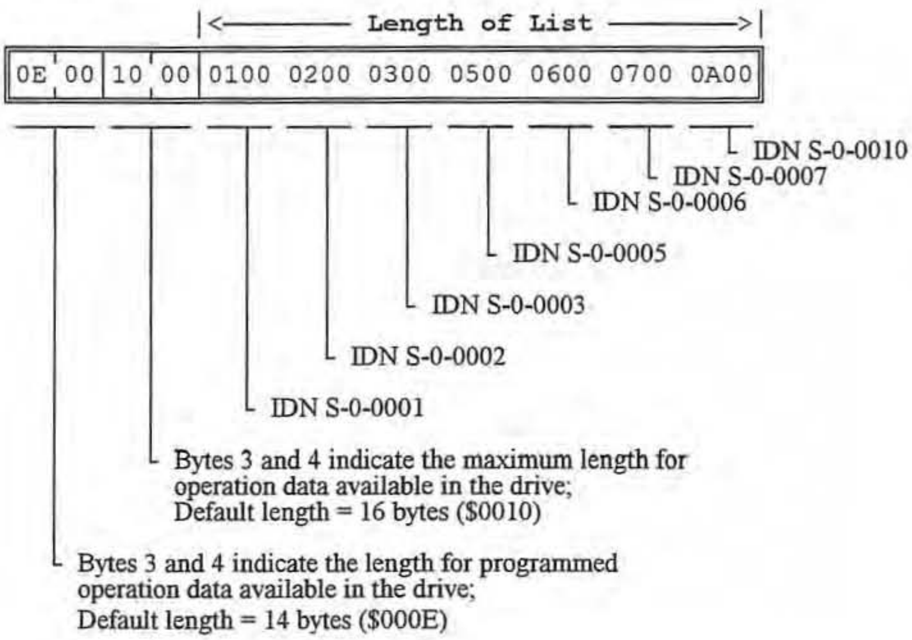


S-0-0017 ID Number List of All Operation Data

All IDNs of all operation data of this drive are stored in the data of this list.

Data Length: Variable, (even number of bytes)
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

Example:

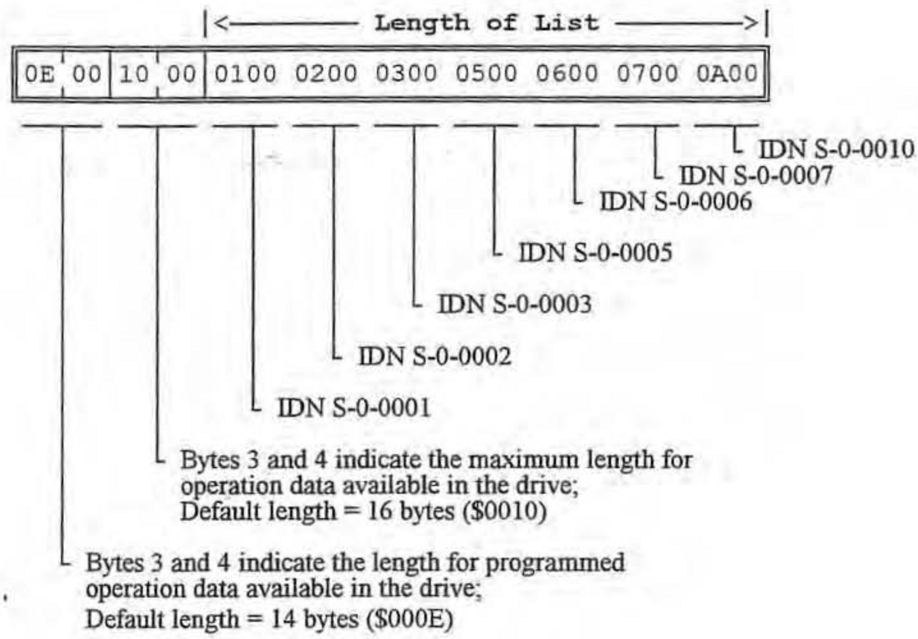


S-0-0021 List of Invalid ID Numbers for Communication Phase 2

Before the control unit advances the communication phase from 2 to 3, the drive must acknowledge that all IDN's required for phase 3 operation is loaded and valid. If there are still invalid IDN's, the drive will give an error in IDN S-0-0095 of 201, (See Chapter 6, Diagnostics). At this time, all invalid IDN's will be placed in this parameter, IDN S-0-0021.

Data Length: Variable, (even number of bytes)
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

Example:

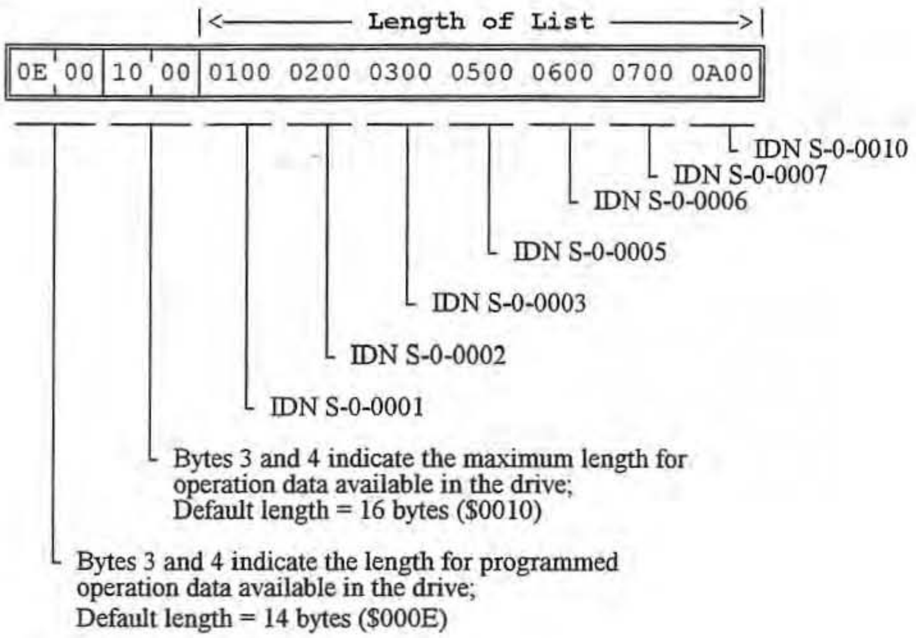


S-0-0022 List of Invalid ID Numbers for Communication Phase 3

Before the control unit advances the communication phase from 3 to 4, the drive must acknowledge that all IDN's required for phase 4 operation is loaded and valid. If there are still invalid IDN's, the drive will give an error in IDN S-0-0095 of 201, (See Chapter 6, Diagnostics). At this time, all invalid IDN's will be placed in this parameter, IDN S-0-0022.

Data Length: Variable, (even number of bytes)
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

Example:



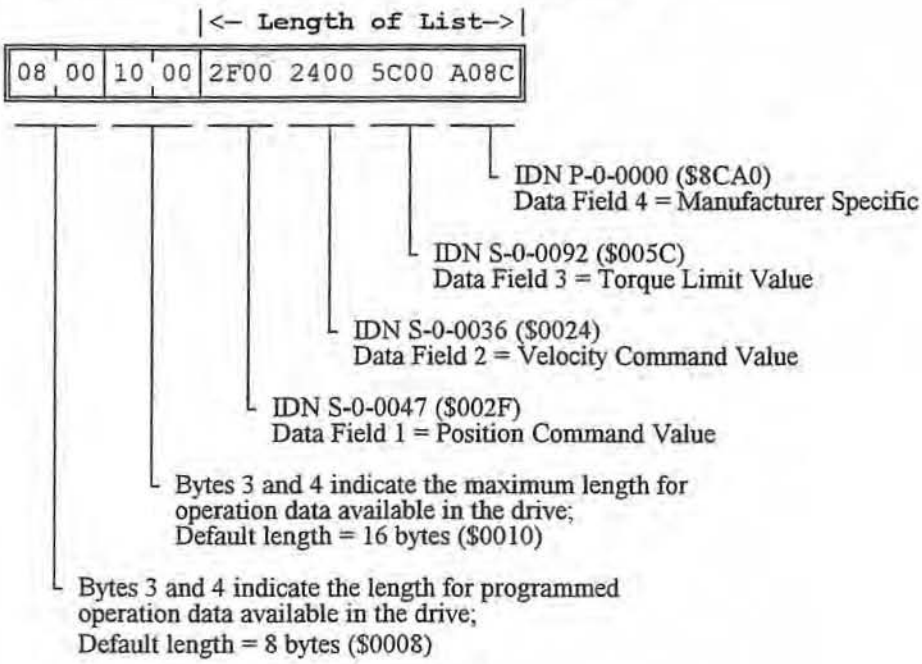
2

S-0-0024 Custom MDT Configuration List

The ID Numbers that will be transmitted cyclically in the MDT are placed in this configuration list. This parameter only needs to be supported if Custom Telegram is selected in IDN S-0-0015. Only ID Numbers that are present in the List of MDT Configurable Data, IDN S-0-0188 are allowed to be added to this configuration list.

Data Length: Variable, (even number of bytes)
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2 (Write protected if Telegram Type, IDN S-0-0015 ≠ 0007h)

Example Structure of MDT Custom Configuration List



S-0-0028 MST Error Counter

The MST error counter counts all invalid MST's in Communication Phases 3 and 4. In the case where more than two consecutive MST's are invalid, only the first two are counted. The MST error counter counts up to a maximum of $2^{16} - 1$. This means that if a value of 65535 is set in the counter, there may have been a noisy transmission over a long period of time.

Data Length: 4 bytes
Min. Input: 0
Max. Input: 65535
Units: # of errors
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0029 MDT Error Counter

The MDT error counter counts all invalid MDT's in Communication Phases 3 and 4. In the case where more than two consecutive MDT's are invalid, only the first two are counted. The MDT error counter counts up to a maximum of $2^{16} - 1$. This means that if a value of 65535 is set in the counter, there may have been a noisy transmission over a long period of time.

Data Length: 4 bytes
Min. Input: 0
Max. Input: 65535
Units: # of errors
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0030 Manufacturer Version

This parameter identifies the DDS 2.1 software version. For the currently available versions, see Appendix H, or contact Indramat Sales or Engineering.

Data Length: Variable, (even number of bytes)
Access Mode: Read in Phase 2 and Phase 4, (Read Only)

S-0-0032 Primary Operation Mode

The drive operation mode defined by this ID Number becomes active when Primary Operation Mode is set in the control word of the MDT, (bits 8 and 9 set to "00"). This information must be supplied before progressing to Communication Phase 3.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
15                             3 2 1 0
x x 0 0 0 0 0 0   0 0 0 0 x x x x
| |                            | | | |
| |                            0 0 0 0 - no mode of operation defined
| |                            0 0 0 1 - torque loop control
| |                            0 0 1 0 - velocity loop control
| |                            x 0 1 1 - position loop control using feedback 1
| |                            x 1 0 0 - position loop control using feedback 2
| |                            x 1 0 1 - position control using feedbacks 1 & 2
| |                            x 1 1 0 - reserved
| |                            0 1 1 1 - operation mode without closed loops
| |                            |
| |                            0 - position control with following error
| |                            1 - position control without following error
| 0 - cyclic command values
| 1 - ignore cyclic command values
|
0 - operation mode defined by SERCOS
1 - operation mode defined by product
```

Note: Position feedback 1 = Motor feedback
Position feedback 2 = External feedback

S-0-0033 Secondary Operation Mode - 1

The drive operation mode defined by this ID Number becomes active when the Secondary Operation Mode - 1 is set in the control word of the MDT, (bits 8 and 9 set to "01").

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
15                         3 2 1 0
 x x 0 0 0 0 0 0   0 0 0 0 x x x x
 | |                       | | | |
 | |                       0 0 0 0 - no mode of operation defined
 | |                       0 0 0 1 - torque loop control
 | |                       0 0 1 0 - velocity loop control
 | |                       x 0 1 1 - position loop control using feedback 1
 | |                       x 1 0 0 - position loop control using feedback 2
 | |                       x 1 0 1 - position control using feedbacks 1 & 2
 | |                       x 1 1 0 - reserved
 | |                       0 1 1 1 - operation mode without closed loops
 | |                       |
 | |                       0 - position control with following error
 | |                       1 - position control without following error
 | 0 - cyclic command values
 | 1 - ignore cyclic command values
 |
 0 - operation mode defined by SERCOS
 1 - operation mode defined by product
```

Note: Position feedback 1 = Motor feedback
Position feedback 2 = External feedback

S-0-0034 Secondary Operation Mode - 2

The drive operation mode defined by this ID Number becomes active when the Secondary Operation Mode - 2 is set in the control word of the MDT, (bits 8 and 9 set to "10").

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
 15                             3 2 1 0
┌─────────────────────────────────────────┐
│x x 0 0 0 0 0 0 │ 0 0 0 0 x x x x│
└─────────────────────────────────────────┘
 | |                            | | | |
 | |                            0 0 0 0 - no mode of operation defined
 | |                            0 0 0 1 - torque loop control
 | |                            0 0 1 0 - velocity loop control
 | |                            x 0 1 1 - position loop control using feedback 1
 | |                            x 1 0 0 - position loop control using feedback 2
 | |                            x 1 0 1 - position control using feedbacks 1 & 2
 | |                            x 1 1 0 - reserved
 | |                            0 1 1 1 - operation mode without closed loops
 | |                            |
 | |                            0 - position control with following error
 | |                            1 - position control without following error
 | 0 - cyclic command values
 | 1 - ignore cyclic command values
 |
 0 - operation mode defined by SERCOS
 1 - operation mode defined by product
```

Note: Position feedback 1 = Motor feedback
Position feedback 2 = External feedback

S-0-0035 Secondary Operation Mode - 3

The drive operation mode defined by this ID Number becomes active when the Secondary Operation Mode - 3 is set in the control word of the MDT, (bits 8 and 9 set to "11").

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
 15                            3 2 1 0
┌────────────────┬────────────────┐
│x x 0 0 0 0 0 0 │ 0 0 0 0 x x x x│
└────────────────┴────────────────┘
 | |                     | | | |
 | |                     0 0 0 0 - no mode of operation defined
 | |                     0 0 0 1 - torque loop control
 | |                     0 0 1 0 - velocity loop control
 | |                     x 0 1 1 - position loop control using feedback 1
 | |                     x 1 0 0 - position loop control using feedback 2
 | |                     x 1 0 1 - position control using feedbacks 1 & 2
 | |                     x 1 1 0 - reserved
 | |                     0 1 1 1 - operation mode without closed loops
 | |                     |
 | |                     0 - position control with following error
 | |                     1 - position control without following error
 | 0 - cyclic command values
 | 1 - ignore cyclic command values
 |
 0 - operation mode defined by SERCOS
 1 - operation mode defined by product
```

Note: Position feedback 1 = Motor feedback
Position feedback 2 = External feedback

S-0-0036 Velocity Command Value

When the drive operating mode "Velocity Loop Control" is activated, the control unit transfers the velocity command value to the drive every cycle.

Data Length: 4 bytes
Min. Input: -2147483.647
Max. Input: +2147483.647
Scaling: Scaling Options - IDN S-0-0044
Scaling Factor - IDN S-0-0045
Scaling Exponent - IDN S-0-0046
Preferred Scaling:
Rotational = 1×10^{-4} or 1×10^{-6} revolutions/sec
Linear = 1×10^{-6} m/min or 1×10^{-5} in/min
Access Mode: Read in Phase 2 and Phase 4

Write in Phase 4

S-0-0040 Velocity Feedback Value

This value, which represents the actual velocity of the motor, can be sent from the DDS 2.1 to the control unit cyclically or via the service channel for processing by the control unit.

Data Length: 4 bytes
Min. Input: -2147483.647
Max. Input: +2147483.647
Scaling: Scaling Options - IDN S-0-0044
Scaling Factor - IDN S-0-0045
Scaling Exponent - IDN S-0-0046
Preferred Scaling:
Rotational = 1×10^{-4} or 1×10^{-6} revolutions/sec
Linear = 1×10^{-6} m/min or 1×10^{-5} in/min
Access Mode: Read in Phase 2 and Phase 4, (Read Only)

S-0-0041 Homing Velocity

The Homing Velocity is the velocity that the motor will operate at during drive controlled homing. This parameter is required when the drive is closing a position loop and the drive controlled homing procedure is executed.

Data Length: 4 bytes
Min. Input: -2147483.647
Max. Input: +2147483.647
Scaling: Scaling Options - IDN S-0-0044
Scaling Factor - IDN S-0-0045
Scaling Exponent - IDN S-0-0046
Preferred Scaling:
Rotational = 1×10^{-4} or 1×10^{-6} revolutions/sec
Linear = 1×10^{-6} m/min or 1×10^{-5} in/min
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0042 Homing Acceleration

The Homing Acceleration is the acceleration that the motor will operate at during drive controlled homing. This parameter is required when the drive is closing a position loop and the drive controlled homing procedure is executed.

Data Length: 4 bytes
Min. Input: 0
Max. Input: $+2^{31} - 1$
Scaling: Scaling Options - IDN S-0-0160
Scaling Factor - IDN S-0-0161
Scaling Exponent - IDN S-0-0162
Preferred Scaling:
Rotational = 1×10^{-3} rad/sec^2
Linear = 1×10^{-6} m/sec^2
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

2

S-0-0043 Velocity Polarity Parameter

This IDN is used to switch the polarity of the velocity data for specific applications. The polarity is switched on the outside of a closed loop system, (i.e. on the input and output). The motor shaft will turn clockwise, (looking at the motor from the shaft side), when a positive velocity command error is present and no inversion is specified.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 x x x |
                             |   |
                             |   └─ Commanded Velocity
                             |      0 - Non-inverted
                             |      1 - Inverted
                             |
                             └─ Velocity Feedback Value
                                0 - Non-inverted
                                1 - Inverted
```

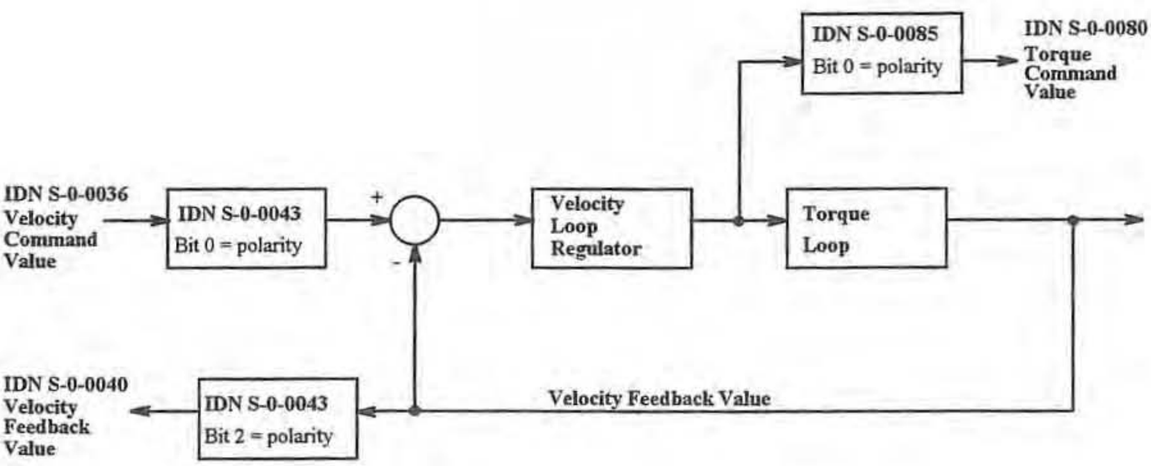


Figure 2.7 Parameter Values for Velocity Polarity

S-0-0044 Scaling Options for Velocity Data

A variety of parameters may be selected in this IDN to determine the method in which velocity data is read and interpreted.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
15                 6 5 4 3 2 1 0
| r r r r r r r r r  r x x x x 0 x x |

                   | | | | | | | Bit 2-0: Scaling Method
                   x 0 0 0 0 0 0 - no scaling
                   1 x x x 0 0 1 - linear scaling
                   x x 0 x 0 1 0 - rotational scaling
                   | | | |
                   | | | | Bit 3:
                   | | | 0 - preferred scaling
                   | | | 1 - parameter scaling
                   | | |
                   | | | Bit 4: Units for linear scaling
                   | | 0 - meters [m]
                   | | 1 - inches [in]
                   | | |
                   | | | Bit 4: Units for rotational scaling
                   | | 0 - revolutions
                   | | 1 - reserved
                   | |
                   | | Bit 5: Time scaling
                   | 0 - minutes [min]
                   | 1 - seconds [s]
                   |
                   | Bit 6: Data reference
                   0 - At the motor shaft
                   1 - At the load
```

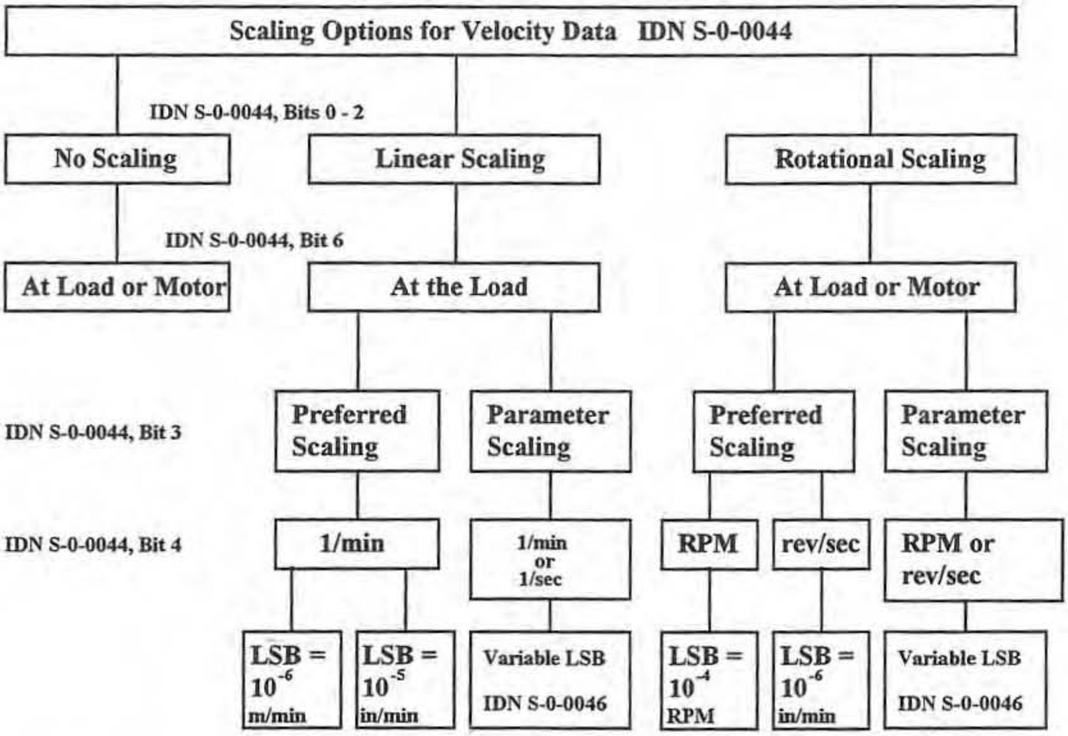


Figure 2.8 Scaling Options for Velocity Data

S-0-0045 Linear Velocity Data Scaling Factor

This ID Number contains the scaling factor that is to be used for scaling all velocity data in the drive. This parameter is write protected if preferred scaling is selected in IDN S-0-0044 (bit 3 = "0").

Data Length: 2 bytes
Min. Input: 1
Max. Input: 65535
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
15              8 7             0
+-------------------------------+
|            Factor             |
+-------------------------------+
```

S-0-0046 Linear Velocity Data Scaling Exponent

This ID Number contains the scaling exponent that is to be used for scaling all velocity data in the drive. This parameter is write protected if preferred scaling is selected in IDN S-0-0044 (bit 3 = "0").

Data Length: 2 bytes
Min. Input: -32767
Max. Input: +32767
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
15              8 7             0
+-------------------------------+
|           Exponent            |
+-------------------------------+
|
| Bit 15: Sign of Exponent
0 - positive
1 - negative
```

S-0-0047 Position Command Value

When the drive operating mode "Position Loop Control" is activated, the control unit transfers the position command value to the drive every cycle.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 4

S-0-0049 Positive Position Limit Value

This limit value describes the maximum travel distance in the positive direction. This IDN is only enabled when all position data is based on the home position. The position polarity parameter can be used to disable the position limit values. When the positive position limit value is exceeded, the drive sets an error bit under Class 1 Diagnostics, (IDN S-0-0011) and/or sets a warning bit under Class 2 Diagnostics, (IDN S-0-0012), depending on the drives internal functionality.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0050 Negative Position Limit Value

This limit value describes the maximum travel distance in the negative direction. This IDN is only enabled when all position data is based on the home position. The position polarity parameter can be used to disable the position limit values. When the negative position limit value is exceeded, the drive sets an error bit under Class 1 Diagnostics, (IDN S-0-0011) and/or sets a warning bit under Class 2 Diagnostics, (IDN S-0-0012), depending on the drives internal functionality.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0051 Position Feedback Value 1, (Motor Encoder)

This value, which represents the actual position of the motor, can be sent from the DDS 2.1 to the control unit cyclically or via the service channel for processing by the control unit.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4, (Read Only)

S-0-0052 Position Feedback 1 - Reference Distance

This parameter contains the distance from the machine zero point to a fixed reference point as measured by position feedback 1, (motor encoder).

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0053 Position Feedback Value 2, (External Feedback)

This value, which represents the position where the external feedback is mounted, can be sent from the DDS 2.1 to the control unit cyclically or via the service channel for processing by the control unit.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4, (Read Only)

S-0-0054 Position Feedback 2 - Reference Distance

This parameter contains the distance from the machine zero point to a fixed reference point as measured by position feedback 2, (external encoder).

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

2

S-0-0055 Position Polarity Parameter

This IDN is used to switch the polarity of the position data for specific applications. The polarity is switched on the outside of a closed loop system, (i.e. on the input and output). The motor shaft will turn clockwise, (looking at the motor from the shaft side), when a positive position command error is present and no inversion is specified.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
0 0 0 0 0 0 0 0   0 0 0 x x x x x
                        | | |   |
                        | | |   |- Commanded Position
                        | | |   0 - Non-inverted
                        | | |   1 - Inverted
                        | | |
                        | | |- Position Feedback Value - 1
                        | | 0 - Non-inverted
                        | | 1 - Inverted
                        | |
                        | |- Position Feedback Value - 2
                        | 0 - Non-inverted
                        | 1 - Inverted
                        |
                        |- Position Limit Value
                        0 - Disabled
                        1 - Enabled
```

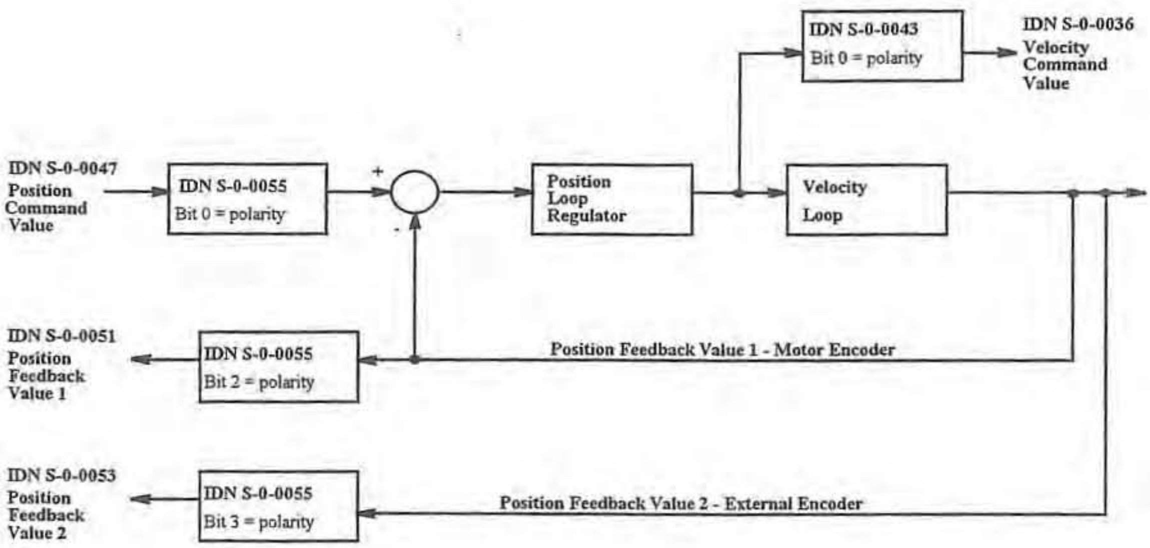


Figure 2.9 Parameter Values for Position Polarity

S-0-0057 In Position Window

When the motor position is found to be near home, within the limits defined by the position window, it is considered to be at home and the drive will acknowledge as such. This function is also used for the single axis mode to determine the limits in which the axis is considered to be in its final position.

Data Length: 4 bytes
Min. Input: 0
Max. Input: 214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0076 Scaling Options for Position Data

A variety of parameters may be selected in this IDN to determine the method in which position data is read and interpreted.

Data Length: 2 bytes

Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
15                 7 6 5 4 3 2 1 0
0 0 0 0 0 0 0 0    0 0 0 0 x x x x
```

Bit 2-0: Scaling Method

```
0 x 0 0 0 0 0 0 - no scaling
0 1 0 x x 0 0 1 - linear scaling
x x 0 0 x 0 1 0 - rotational scaling
```

Bit 3:
0 - preferred scaling
1 - parameter scaling

Bit 4: Units for linear scaling
0 - meters [m]
1 - inches [in]

Bit 4: Units for rotational scaling
0 - degrees
1 - reserved

Bit 5:
0 - reserved
1 - reserved

Bit 6: Data reference
0 - At the motor shaft
1 - At the load

Bit 7: Processing Format
0 - Absolute Format
1 - Modulo Format (See IDN S-0-0103)

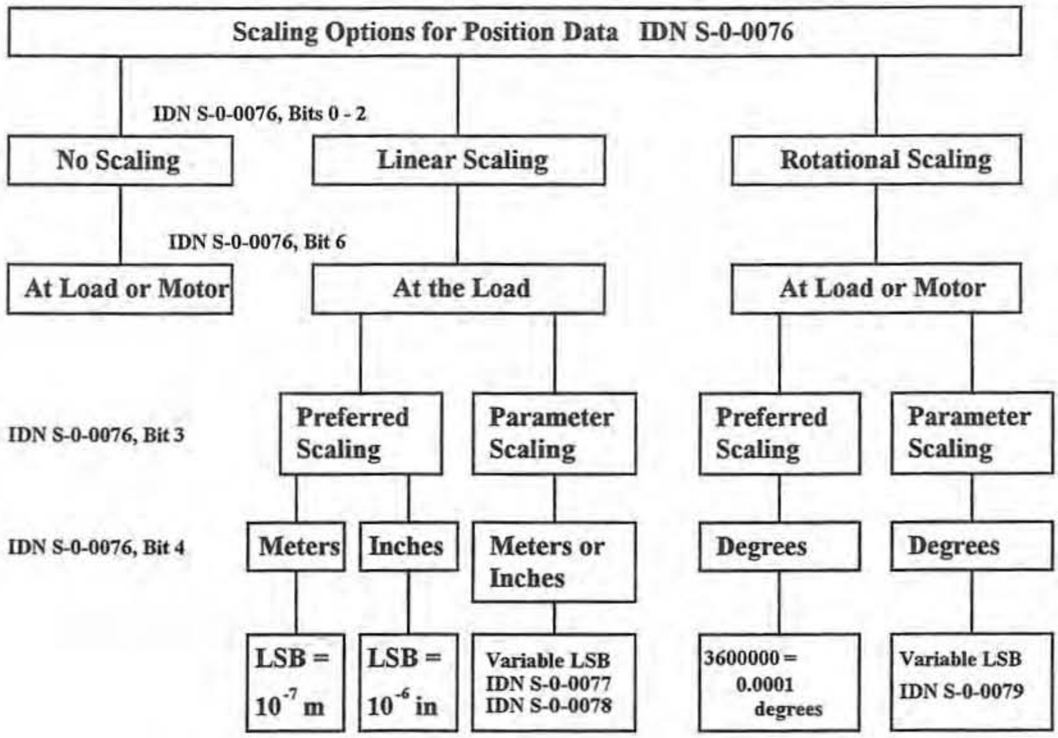


Figure 2.10 Scaling Options for Position Data

S-0-0077 Linear Position Data Scaling Factor

This ID Number contains the scaling factor that is to be used for scaling all position data in the drive. This parameter is used by the drive only if parameter scaling is selected in bit 3 and linear scaling is selected in bits 0 to 2 of IDN S-0-0076.

Data Length: 2 bytes
Min. Input: 1
Max. Input: 65535
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
15              8 7              0
+--------------------------------+
|            Factor              |
+--------------------------------+
```

S-0-0078 Linear Position Data Scaling Exponent

This ID Number contains the scaling exponent that is to be used for scaling all position data in the drive. This parameter is used by the drive only if parameter scaling is selected in bit 3 and linear scaling is selected in bits 0 to 2 of IDN S-0-0076.

Data Length: 2 bytes
Min. Input: -32767
Max. Input: +32767
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
15              8 7              0
+--------------------------------+
|            Exponent            |
+--------------------------------+
|
| Bit 15: Sign of Exponent
0 - positive
1 - negative
```

S-0-0079 Rotational Position Resolution

This ID Number contains the rotational position resolution that is to be used for all position data in the drive. The value is entered in binary format. This parameter is used by the drive only if parameter scaling is selected in bit 3 and rotational scaling is selected in bits 0 to 2 of IDN S-0-0076.

Data Length: 4 bytes
Min. Input: 1
Max. Input: $+2^{32} - 1$
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

31	0
Rotational Position Resolution	

The LSB weight can be calculated as follows:

$$\text{LSB Weight} = \frac{1 \text{ revolution}}{\text{Rotational Position Resolution}}$$

Example:

If a resolution down to .01 degrees were desired for the LSB weight, a value of 36,000 would need to be entered. Therefore, the value to be entered in this parameter is 8CA0H, or:

31			0
0000 0000	0000 0000	1000 1100	1010 0000

In the case where preferred scaling is selected in bit 3 of IDN S-0-0076, the rotational position resolution is fixed at 3,600,000. This relates to a LSB weight of 0.0001 angular degrees.

S-0-0080 Torque Command Value

When the drive operating mode "Torque Loop Control" is activated, the control unit transfers the torque command value to the drive every cycle.

Data Length: 2 bytes
Min. Input: -3276.7

Max. Input: +3276.7
Scaling: Scaling Options - IDN S-0-0086
Scaling Factor - IDN S-0-0093
Scaling Exponent - IDN S-0-0094
Preferred Scaling:
Percentage = 0.1% of motor nominal torque
Rotational = 0.01 Nm
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 4

S-0-0084 Torque Feedback Value

This value, which represents the actual torque of the motor, can be sent from the DDS 2.1 to the control unit cyclically or via the service channel for processing by the control unit.

Data Length: 2 bytes
Min. Input: -3276.7
Max. Input: +3276.7
Scaling: Scaling Options - IDN S-0-0086
Scaling Factor - IDN S-0-0093
Scaling Exponent - IDN S-0-0094
Preferred Scaling:
Percentage = 0.1% of motor nominal torque
Rotational = 0.01 Nm
Access Mode: Read in Phase 2 and Phase 4, (Read Only)

S-0-0085 Torque Polarity Parameter

This IDN is used to switch the polarity of the torque data for specific applications. The polarity is switched on the outside of a closed loop system, (i.e. on the input and output). The motor shaft will turn clockwise, (looking at the motor from the shaft side), when a positive torque command error is present and no inversion is specified.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
0 0 0 0 0 0 0 0 | 0 0 0 0 0 x x x
```

Commanded Torque
0 - Non-inverted
1 - Inverted

Torque Feedback Value
0 - Non-inverted
1 - Inverted

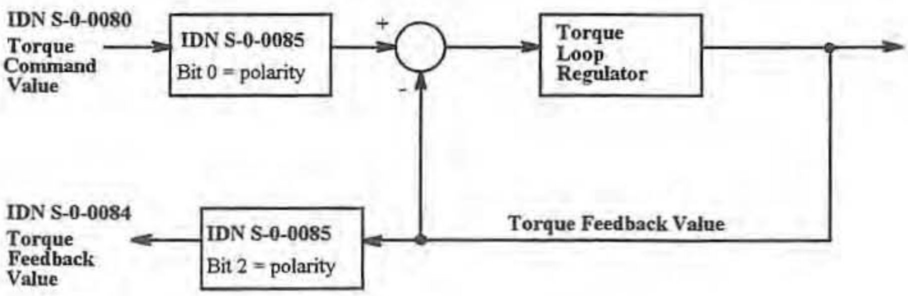


Figure 2.11 Parameter Values for Torque Polarity

S-0-0086 Scaling Options for Torque - Force Data

A variety of torque-force scaling options can be selected for all torque-force data as described below:

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

```
15                    6 5 4 3 2 1 0
+----------------------------------+
|0 0 0 0 0 0 0 0 0 | 0 x 0 x x 0 x x|
+----------------------------------+
                      | | | | | | |
                      | | | | | | | Bit 2-0: Scaling Option
                      x 0 0 0 0 0 0 - percentage scaling
                      1 0 x x 0 0 1 - linear scaling (force)
                      x 0 x x 0 1 0 - rotational scaling (torque)
                      | | | |
                      | | | | Bit 3:
                      | | | 0 - preferred scaling
                      | | | 1 - parameter scaling
                      | | |
                      | | | Bit 4: Units for force
                      | | 0 - Newtons [N]
                      | | 1 - pound-force [lbf]
                      | | |
                      | | | Bit 4: Units for torque
                      | | 0 - Newton-meter [Nm]
                      | | 1 - inch-pound-force [in-lbf]
                      | |
                      | | Bit 5:
                      | 0 - reserved
                      | 1 - reserved
                      |
                      | Bit 6: Data reference
                      0 - At the motor shaft
                      1 - At the load
```

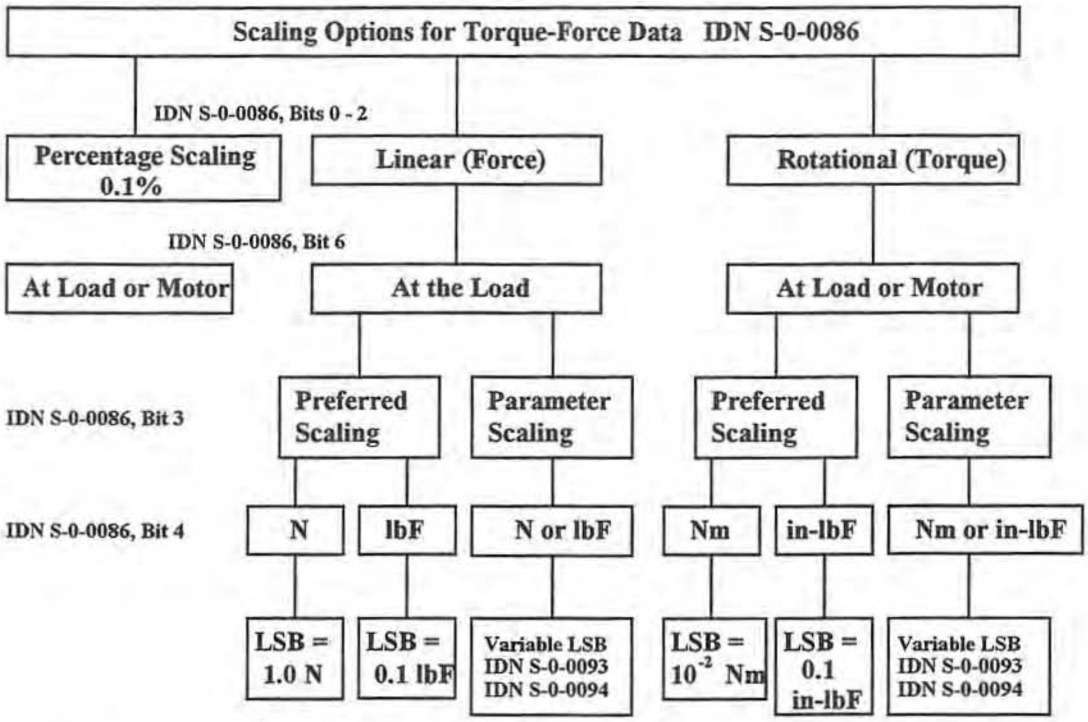


Figure 2.12 Scaling Options for Torque-Force Data

S-0-0088 Receive to Receive Recovery Time, (t_{MTSY})

The time required by the DDS 2.1 to switch from receiving the MDT to receiving the next MST. This parameter is read by the Master during Communication Phase 2 to insure that enough time is available between the end of the MDT and beginning of the MST.

Data Length:	2 bytes
Scaling:	1µsec
Units:	µsec
Access Mode:	Read in Phase 2 and Phase 4 (Read Only)

S-0-0089 MDT Transmit Starting Time, (t_2)

The MDT Transmit Starting Time determines the time after the MST in which the Master will send it's MDT during Communication Phases 3 and 4. This value is loaded by the master during Communication Phase 2 and becomes active in Communication Phase 3 of Initialization.

Data Length:	2 bytes
Min. Input:	1µsec
Max. Input:	65000µsec
Scaling:	1µsec
Units:	µsec
Access Mode:	Read in Phase 2 and Phase 4 Write in Phase 2

S-0-0090 Command Value Transmit Time, (t_{MTSG})

The time required by the DSS 1.1 to make command values available to the DDS 2.1 after the receipt of the MDT. The Master reads this value during Communication Phase 2 in order to calculate the Command Valid Time, IDN S-0-0008. The Command Value Transmit Time depends on the telegram type that was selected.

Data Length:	2 bytes
Scaling:	1µsec

S-0-0091 Bipolar Velocity Limit Value

The bipolar velocity limit value determines the maximum allowable speed in either direction. If the velocity limit value is exceeded, the drive responds by setting the message "$n_{command} > n_{limit}$" in Class 3 Diagnostics (IDN S-0-0013).

Data Length: 4 bytes
Min. Input: 0
Max. Input: +2147483.647
Scaling: Scaling Options - IDN S-0-0044
Scaling Factor - IDN S-0-0045
Scaling Exponent - IDN S-0-0046
Preferred Scaling:
Rotational = 1×10^{-4} RPM or 1×10^{-6} rad/sec
Linear = 1×10^{-6} m/min or 1×10^{-5} in/min
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0092 Bipolar Torque Limit Value

The bipolar velocity limit value determines the maximum allowable torque in either direction. If the torque limit value is exceeded, the drive sets the message "$T > T_{limit}$" in Class 3 Diagnostics (IDN S-0-0013).

Data Length: 2 bytes
Min. Input: 0
Max. Input: 3276.7
Scaling: Scaling Options - IDN S-0-0086
Scaling Factor - IDN S-0-0093
Scaling Exponent - IDN S-0-0094
Preferred Scaling:
Percentage = 0.1% of motor nominal torque
Rotational = 0.01 Nm
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0093 Scaling Factor for Torque-Force Data

This ID Number contains the scaling factor that is to be used for scaling all torque-force data in the drive.

Data Length:	2 bytes
Min. Input:	1
Max. Input:	65535
Access Mode:	Read in Phase 2 and Phase 4 Write in Phase 2

```
15            8 7            0
+----------------------------+
|           Factor           |
+----------------------------+
```

S-0-0094 Scaling Exponent for Torque-Force Data

This ID Number contains the scaling exponent that is to be used for scaling all torque-force data in the drive.

Data Length:	2 bytes
Min. Input:	-32767
Max. Input:	+32767
Access Mode:	Read in Phase 2 and Phase 4 Write in Phase 2

```
15            8 7            0
+----------------------------+
|          Exponent          |
+----------------------------+
|
| Bit 15: Sign of Exponent
0 - positive
1 - negative
```

S-0-0095 Diagnostic Message

The status of the DDS 2.1 is described by the 2-digit code on the H1 display of the drive. In addition, a text message corresponding to the status is also generated by the drive and stored in this parameter. When a blinking "32" code appears on the H1 display, this parameter can be viewed to see the actual diagnostic. (See Chapter 6 for a list of diagnostic messages.)

Data Length: Variable in 1 byte increments, (ASCII characters)
Access Mode: Read in Phase 2 and Phase 4, (Read Only)

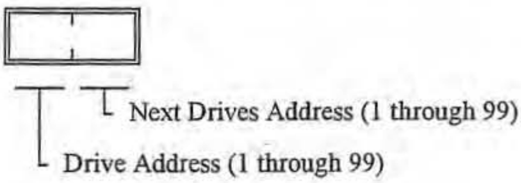
Example:

```
                  A  m  p  l  i  f  i  e  r     R  e  a  d  y
| 0F | 00 | 28 | 00 | 41 6D 70 6C 69 66 69 65 72 20 52 65 65 64 79 |
  |         |        |<- Length of Diagnostic Message (15 Char.) ->|
  |         |
  |         └── Bytes 3 and 4 indicate the maximum length for
  |             operation data available in the drive;
  |             Default length = 40 bytes ($0028)
  |
  └── Bytes 1 and 2 indicate the length of the programmed
      operation data available in the drive;
      Default length = 15 bytes ($000F)
```

S-0-0096 Slave Arrangement, (SLKN)

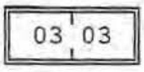
During initialization, the Master needs to know what drives are present under each slave in order to optimize the automatic time slot computation. The Master may request this information from the drives during Communication Phase 2. Valid drive addresses range from 01 to 99. Since each DDS 2.1 is configured with one drive per slave, (DSS 1.1), then "Next Drives Address" = "Drive Address".

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4, (Read Only)



Example:

A drive with an address of "03" has a value of:



S-0-0099 Reset Class 1 Diagnostics

When this command is received by the drive via the service channel and no error exists, the Class 1 Diagnostic bit, the Interface Status, the Product Defined Class 1 Diagnostic bit and the drive shutdown mechanism are all reset.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0100 Velocity Loop Proportional Gain

This is a proportional gain only for the velocity loop regulator. In order to adjust this gain automatically for a particular motor and drive combination, you must perform the "Load Default Gain Parameters" Procedure Command, IDN S-0-0262. This adjustment assumes a 1:1 ratio of load inertia to motor inertia. This proportional gain has a fixed relationship to the velocity loop integral gain through the Velocity Loop Integral Action Time, IDN S-0-0101. This allows the drive to be tuned by adjusting the velocity loop proportional gain only. A block diagram of the velocity loop regulator is shown in following figure.

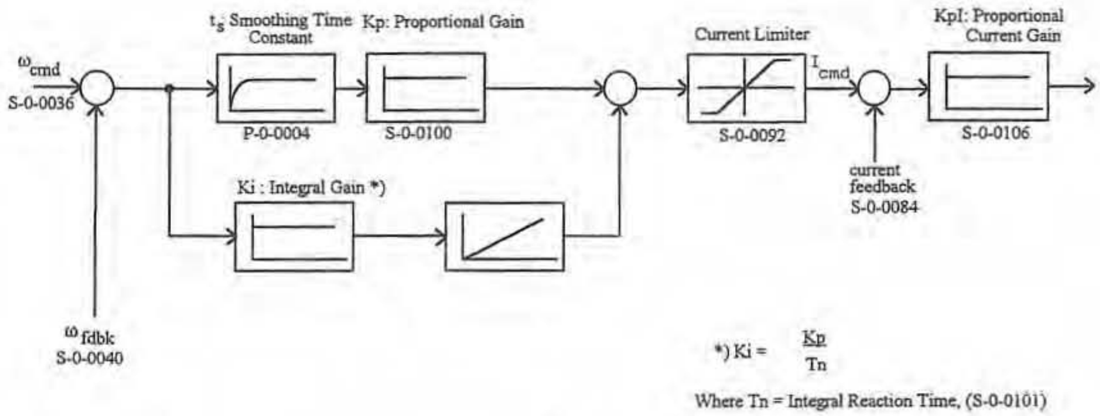


Figure 2.13 Velocity Loop Proportional Gain

Data Length:	2 bytes
Min. Input:	0
Max. Input:	65535
Units:	mAsec / rad
Access Mode:	Read in Phase 2 and Phase 4
	Write in Phases 2, 3 and 4

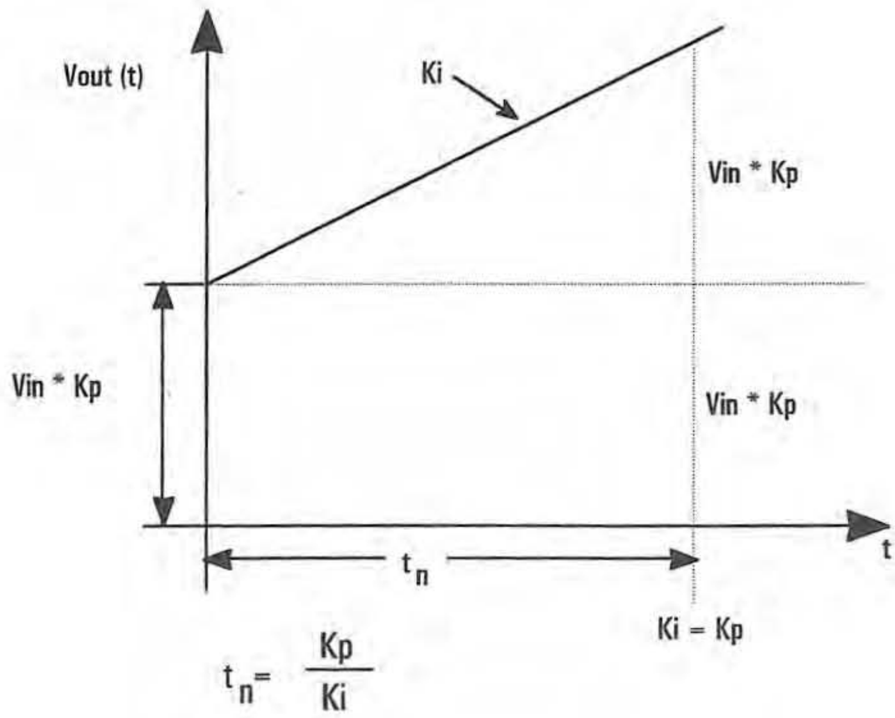
S-0-0101 Velocity Loop Integral Reaction Time

This value relates the velocity loop proportional gain, Kp to the velocity loop integral gain by the ratio:

$$Ki = \frac{Kp}{t_n}$$

Where t_n is the velocity loop integral reaction time.

The definition of t_n is the time when the Ki gain equals the Kp gain.



Since this relationship exists, it is not necessary to adjust the integral gain when tuning the drive. It is only necessary to adjust the velocity loop proportional gain. (See IDN S-0-0100).

Data Length:	2 bytes
Min. Input:	0
Max. Input:	6553.5
Units:	msec
Access Mode:	Read in Phase 2 and Phase 4 Write in Phases 2, 3 and 4

S-0-0103 Modulo Value

The modulo value is indicated as a maximum rotational value in which the motor will turn before resetting the position to zero. The default value when operating in modulo mode is 360°. (Modulo mode is set in the drive by setting bit 7 of IDN S-0-0076, Scaling Options for Position Data).

Data Length: 4 bytes
Min. Input: 0
Max. Input: 214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2

S-0-0104 Position Loop Gain, (KV Factor)

This is a proportional gain only for the position loop regulator. This gain defined in terms of the following error of the system in units of m/min/mil. For a block diagram of the position loop regulator, see figure below.

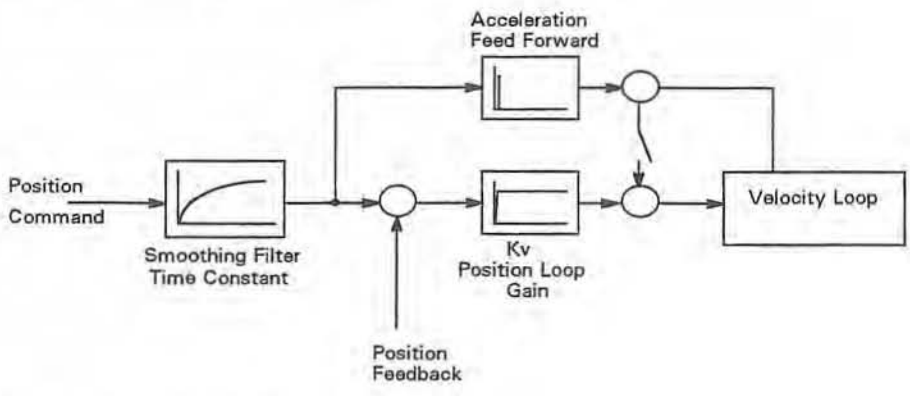


Figure 2.14 Position Loop Regulator

Data Length: 2 bytes
Min. Input: .1
Max. Input: 29.0
Scaling: 0.01 (m/min)/mm
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0106 Current Loop Proportional Gain 1

This is the proportional gain for the current loop regulator. This gain is adjusted by the drive automatically for any motor/drive combination. This adjustment is defined by the type of motor used and should not be changed.

Data Length: 2 bytes
Min. Input: .01
Max. Input: 655.35
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0108 Feedrate Override

The feedrate override is activated only with drive controlled procedure commands. In this case, the velocity command value is calculated by the drive internally. The cyclic data containing velocity command data is ignored when this function is active.

Data Length: 2 bytes
Min. Input: 0
Max. Input: 655.35
Scaling: 0.01%
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0109 Motor Peak Current

If the peak current of the motor is less than that of the DDS 2.1 drive, the drive then automatically limits its peak current to that of the motor. This data is factory programmed in the feedback of the motor and should not be changed.

Data Length: 4 bytes

Min. Input: 0
Max. Input: 2147483.647
Scaling: 1mA
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0110 Amplifier Peak Current

This is the peak current that is allowed by the DDS 2.1 as is specified in its type code, (see Appendix A).

Data Length: 4 bytes
Min. Input: 0
Max. Input: 2147483.647
Scaling: 1mA
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0111 Continuous Motor Current

This value represents the motors continuous current at standstill that is determined by the motors continuous standstill torque. This value is stored in the motor feedback and this parameter is set when the motor/drive system is first started up.

Data Length: 4 bytes
Min. Input: 0
Max. Input: 2147483.647
Scaling: 1mA
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0112 Amplifier Continuous Current

This value represents the DDS 2.1 allowable continuous current. This value is set automatically by the drive.

Data Length: 4 bytes
Min. Input: 0
Max. Input: 2147483.647
Scaling: 1mA
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

2

S-0-0113 Maximum Motor Velocity

This is the maximum motor velocity that the respective motor may run. See motor data sheet and DDS 2.1 Selection Guide for more information.

Data Length: 4 bytes
Min. Input: 0.25
Max. Input: 214748.3647
Scaling: 10^{-4} RPM
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0115 Position Feedback Type Parameter

This IDN defines the type and setup of an external feedback that is applied to the respective drive. (See also IDN S-0-0117 and IDN S-0-0118)

Data Length: 2 bytes

```
15             8  7       3 2 1 0
0 0 0 0 0 0 0 0   0 0 0 0 x x x x
                          | | | |
                          | | | |- Feedback Type
                          | | |    0 - Rotational Feedback
                          | | |    1 - Linear Feedback
                          | | |
                          | | |- Referencing
                          | |    0 - Only one marker pulse
                          | |    1 - Distance coded reference marks
                          | |
                          | |- Units
                          |    0 - Metric
                          |    1 - Inches
                          |
                          |- Polarity
                             0 - not inverted
                             1 - inverted
```

S-0-0117 Resolution of Rotational Feedback 2, (External Feedback)

If an additional rotational feedback device is used for positioning directly at the load, (versus the feedback on the motor), this parameter is used to define the resolution of that feedback.

Data Length: 4 bytes
Min. Input: 1
Max. Input: 2147483647
Scaling: 1 count / motor rev.
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2

S-0-0118 Resolution of Linear Feedback 2, (External Feedback)

If an additional linear feedback device is used for positioning directly at the load, (versus the feedback on the motor), this parameter is used to define the resolution of that feedback.

Data Length: 4 bytes
Min. Input: 0
Max. Input: 21474.83647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078

Preferred Scaling: linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2

S-0-0121 Input Revolutions of Load Gear

If gearing is used between the motor and the load, the positioning of the axis must be taken into account. Therefore, the input revolutions of the load gear are entered here.

Data Length: 4 bytes
Min. Input: 1
Max. Input: 2147483647
Scaling: 1 revolution
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2

S-0-0122 Output Revolutions of Load Gear

If gearing is used between the motor and the load, the positioning of the axis must be taken into account. Therefore, the output revolutions of the load gear are entered here.

Data Length:	4 bytes
Min. Input:	1
Max. Input:	2147483647
Scaling:	1 revolution
Access Mode:	Read in Phase 2 and Phase 4 Write in Phases 2

S-0-0123 Feed Constant

The feed constant describes the conversion from rotational motion into linear motion. This is defined as the linear distance per one revolution of the motor shaft when the gear ratio defined by S-0-0121 and S-0-0122 is 1:1. If a gear ratio other than 1:1 is used, the feed constant does not include this gear ratio.

Data Length:	4 bytes
Min. Input:	0
Max. Input:	214748.3647
Scaling:	Scaling Type - IDN S-0-0076 Scaling Factor - IDN S-0-0077 Scaling Exponent - IDN S-0-0078
Preferred Scaling:	Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode:	Read in Phase 2 and Phase 4 Write in Phases 2

S-0-0124 Zero Velocity Window

This window sets a minimum velocity in which the motor operates. If the motor operates below this value, it is considered to be a zero velocity.

Data Length: 4 bytes
Min. Input: 0
Max. Input: 2147483.647
Scaling: Scaling Options - IDN S-0-0044
Scaling Factor - IDN S-0-0045
Scaling Exponent - IDN S-0-0046
Preferred Scaling:
Rotational = 1×10^{-4} RPM or 1×10^{-6} rad/sec
Linear = 1×10^{-6} m/min or 1×10^{-5} in/min
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0127 Communication Phase 3 Transition Check

The Master uses this command to instruct the Slave to check that all necessary communication parameters have been transferred for Communication Phase 3 so that all communication components run error free in Phase 3. (See also IDN S-0-0021).

Data Length: 2 bytes

```
0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 x x
```

Bit 0:
0 - Cancel command in drive
1 - Set command in drive

Bit 1:
0 - Interrupt command execution
1 - Enable command execution

```
0 0 0 0 0 0 0 x | 0 0 0 0 x x x x
```

Bit 0:
0 - Command not set in drive
1 - Command set in drive

Bit 1:
0 - Command execution interrupt in drive
1 - Command execution enabled in drive

Bit 2:
0 - Command executed correctly
1 - Command not yet executed

Bit 3:
0 - No command error
1 - Command execution not possible

Bit 8:
0 - Valid operation data
1 - Invalid operation data

S-0-0128 Communication Phase 4 Transition Check

The Master uses this command to instruct the Slave to check that all necessary data has been transferred for Communication Phase 3 so that all data components run error free in Phase 3.

Data Length: 2 bytes

```
0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 x x
                              | |
                              | 0 - Cancel command in drive
                              | 1 - Set command in drive
                              |
                              0 - Interrupt command execution
                              1 - Enable command execution
```

```
0 0 0 0 0 0 0 x | 0 0 0 0 x x x x
              |         | | | |
              |         | | | 0 - Command not set in drive
              |         | | | 1 - Command set in drive
              |         | | |
              |         | | 0 - Command execution interrupt in drive
              |         | | 1 - Command execution enabled in drive
              |         | |
              |         | 0 - Command executed correctly
              |         | 1 - Command not yet executed
              |         |
              |         0 - No command error
              |         1 - Command execution not possible
              |
              0 - Valid operation data
              1 - Invalid operation data
```

S-0-0130 Probe 1 - Positive Edge Position Value

When the probing procedure is taking place, the drive stores the value of the position feedback to this IDN immediately following the positive edge of the input signal of Probe 1. The position is taken from the external feedback, (position feedback 2), if it is being used. If an external feedback is not used, the position is taken from the motor feedback.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0131 Probe 1 - Negative Edge Position Value

When the probing procedure is taking place, the drive stores the value of the position feedback to this IDN immediately following the negative edge of the input signal of Probe 1. The position is taken from the external feedback, (position feedback 2), if it is being used. If an external feedback is not used, the position is taken from the motor feedback.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0132 Probe 2 - Positive Edge Position Value

When the probing procedure is taking place, the drive stores the value of the position feedback to this IDN immediately following the positive edge of the input signal of Probe 2. The position is taken from the external feedback, (position feedback 2), if it is being used. If an external feedback is not used, the position is taken from the motor feedback.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0133 Probe 2 - Negative Edge Position Value

When the probing procedure is taking place, the drive stores the value of the position feedback to this IDN immediately following the negative edge of the input signal of Probe 2. The position is taken from the external feedback, (position feedback 2), if it is being used. If an external feedback is not used, the position is taken from the motor feedback.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0134 Master Control Word

Allows the display of the Master Control Word on the control units display via the service channel.

Data Length: 2 bytes

x x x r r x x x	x x x r r x x x

Bit 0: "HS"
0/1 - Master Service Transport Handshake

Bit 1: "R/W"
0 - Read Service INFO
1 - Write Service INFO

Bit 2:
0 - Transmission in Progress
1 - Last Transmission

Bit 3-5: "Data Block Element"
0 0 0 - Service Channel not active, close service channel or interrupt a transmission in progress
0 0 1 - ID Number
The service channel is closed for the previous ID Number and opened for a new ID Number
0 1 0 - Name of operation data
0 1 1 - Attribute of operation data
1 0 0 - Units of operation data
1 0 1 - Minimum Input Value
1 1 0 - Maximum Input Value
1 1 1 - Operation Data

Bit 6: Real Time Control Bit 1, (IDN S-0-0300)

Bit 7: Real Time Control Bit 2, (IDN S-0-0302)

Bit 8-9: Commanded Operation Mode
0 0 - Drive in Primary Operation Mode (defined by IDN S-0-0032)
0 1 - Drive in Secondary Operation Mode 2 (defined by IDN S-0-0033)
1 0 - Drive in Secondary Operation Mode 3 (defined by IDN S-0-0034)
1 1 - Drive in Secondary Operation Mode 4 (defined by IDN S-0-0035)

Bit 10: "Control Unit Synchronization Bit"

Bit 13: "Halt Drive"

Bit 14: "Enable Drive"
0 - Drive not enabled
1 - Drive enabled
When changing from 1 to 0, the torque is immediately disabled. (independent of bits 13 and 15)

Bit 15: "Drive ON"
0 - Drive OFF
1 - Drive ON
When changing from 1 to 0, the drive decelerates to 0 RPM as quickly as possible, followed by shutting down of the torque at 0 RPM, (only when bit 14 = 1).

S-0-0135 Drive Status Word

Allows the display of the Drive Status Word on the control units display via the service channel.

Data Length: 2 bytes

```
x x x x x r x x   x x x r r x x x
```

Bit 0: "HS"
0/1 - Master Service Transport Handshake

Bit 1: "Busy"
0 - Step Finished
1 - Step in progress

Bit 2: "Error"
0 - No Error
1 - Error in Service Channel, (error message in Drive Service INFO

Bit 5: "Change Bit Commands"
0 - No change in command status
1 - Changing command status

Bit 6: Real Time Status Bit 1, (IDN S-0-0304)

Bit 7: Real Time Status Bit 2, (IDN S-0-0306)

Bit 8-9: Actual Operation Mode
0 0 - Drive in Primary Operation Mode (defined by IDN S-0-0032)
0 1 - Drive in Secondary Operation Mode 2 (defined by IDN S-0-0033)
1 0 - Drive in Secondary Operation Mode 3 (defined by IDN S-0-0034)
1 1 - Drive in Secondary Operation Mode 4 (defined by IDN S-0-0035)

Bit 11: "Change Bit for Class 3 Diagnostics", (IDN S-0-0013)

Bit 12: "Change Bit for Class 2 Diagnostics", (IDN S-0-0012)

Bit 13: "Drive Shutdown Error, Class 1 Diagnostics", (IDN S-0-0011)

Bit 14-15: "Ready to Operate"
0 0 - Drive not ready for power up
0 1 - Drive ready for power up
1 0 - Drive control section and power supply ready
1 1 - Drive ready to operate

2

S-0-0138 Bipolar Acceleration

The bipolar acceleration parameter reduces the maximum acceleration ability of the drive symmetrically around 0, to the programmed value in both directions.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Type - IDN S-0-0160
Scaling Factor - IDN S-0-0161
Scaling Exponent - IDN S-0-0162
Preferred Scaling:
Rotational = 1×10^{-3} rad/sec^2
linear = 1×10^{-6} m/sec^2
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0140 Drive Type

This contains the type code of the DDS 2.1 to which the current parameter set applies.

Data Length: Variable, (ASCII characters)
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0141 Motor Type

This contains the type code of the MDD motor to which the current parameter set applies.

Data Length: Variable, (ASCII characters)
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0142 Application Type

This ID Number contains a description of the drive application, (e.g., main spindle drive, turning axis, etc.)

Data Length: Variable, (ASCII characters)
Access Mode: Read in Phase 2 and Phase 4
Write in Phases 2, 3 and 4

S-0-0143 SERCOS Interface Version

This ID Number contains the SERCOS Interface Version that is loaded in this drive.

Data Length: Variable, (ASCII characters)
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

S-0-0147 Homing Parameter

This parameter defines the setup for the drive controlled homing procedure.

Data Length: 2 bytes

```
15             8   7   5 4 3 2 1 0
0 0 0 0 0 0 0 0  | 0 0 x x x x x x
```

Homing Direction
0 - motor shaft turns clockwise
1 - motor shaft turns counter clockwise

Position Feedback Marker Pulse
0 - first marker pulse after the positive edge of the home switch.
1 - first marker pulse after the negative edge of the home switch.

Home Switch
0 - connected to the control unit
1 - connected to the drive

Homing
0 - using motor feedback
1 - using external feedback

Interpretation in the Drive
0 - Home switch and homing enable
1 - Homing enable only

Evaluation of the home switch
0 - Home switch is evaluated
1 - Home switch is not evaluated

S-0-0148 Drive Controlled Homing Procedure Command

When the Master sets and enables this command, the drive automatically starts a drive internal position control and accelerates to the homing velocity, (IDN S-0-0041), with an acceleration defined by the homing acceleration parameter, (IDN S-0-0042). The drive resets the bit "Position Feedback Status," (IDN S-0-0403). All changes within the cyclic command, (e.g., velocity command value), are ignored by the drive while the procedure is active.

Once the home switch has been activated, the drive decelerates, (at a rate defined by IDN S-0-0042), and stops on the following marker pulse. The drive then sets bit "Position Feedback Status," (IDN S-0-0403).

The control unit reads the position command value of the drive, (IDN S-0-0047), via the service channel, and sets its own position command value to the same value. Once this is complete, the procedure command is canceled by the control unit, and the drive once again follows the cyclic command values sent by the control unit.

Data Length: 2 bytes

```
0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 x x
```

Bit 0:
- 0 - Cancel command in drive
- 1 - Set command in drive

Bit 1:
- 0 - Interrupt command execution
- 1 - Enable command execution

```
0 0 0 0 0 0 0 x | 0 0 0 0 x x x x
```

Bit 0:
- 0 - Command not set in drive
- 1 - Command set in drive

Bit 1:
- 0 - Command execution interrupt in drive
- 1 - Command execution enabled in drive

Bit 2:
- 0 - Command executed correctly
- 1 - Command not yet executed

Bit 3:
- 0 - No command error
- 1 - Command execution not possible

Bit 8:
- 0 - Valid operation data
- 1 - Invalid operation data

S-0-0149 Drive Into Positive Stop Procedure Command

This procedure command allows the motor to drive into a positive stop without causing a Class 1 Diagnostic, shutdown error to occur. The command is acknowledged positively when $|T| \geq |T_{limit}|$ and $n_{feedback} = 0$.

Data Length: 2 bytes

```
0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 x x
```

- Bit 0: 0 - Cancel command in drive; 1 - Set command in drive
- Bit 1: 0 - Interrupt command execution; 1 - Enable command execution

```
0 0 0 0 0 0 0 x | 0 0 0 0 x x x x
```

- Bit 0: 0 - Command not set in drive; 1 - Command set in drive
- Bit 1: 0 - Command execution interrupt in drive; 1 - Command execution enabled in drive
- Bit 2: 0 - Command executed correctly; 1 - Command not yet executed
- Bit 3: 0 - No command error; 1 - Command execution not possible
- Bit 8: 0 - Valid operation data; 1 - Invalid operation data

S-0-0150 Reference Offset 1

This parameter contains the distance between the Position Feedback 1 - Reference Distance, (IDN S-0-0052), and the home position as determined by the respective marker pulse of position feedback 1.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches

S-0-0151 Reference Offset 2

This parameter contains the distance between the Position Feedback 2 - Reference Distance, (IDN S-0-0054), and the home position as determined by the respective marker pulse of position feedback 2.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches

S-0-0155 Friction Torque Compensation

The friction torque compensation is added directly to the torque command value. This compensation value must also have the same sign as the torque command value. The addition of the friction torque compensation value helps to compensate for the frictional grip when accelerating from a stand still position and during reversals.

Data Length:	2 bytes
Min. Input:	0
Max. Input:	3276.7
Scaling:	Scaling Type - IDN S-0-0086 Scaling Factor - IDN S-0-0093 Scaling Exponent - IDN S-0-0094

Preferred Scaling:

Percentage = 0.1% of motor stall torque
Rotational = 0.01 Nm

S-0-0159 Monitoring Window

The maximum following error that is allowed by the position loop can be defined in the monitoring window. When the position error exceeds the maximum window value, the drive sets an excessive position error in Class 1 Diagnostics, IDN S-0-0011.
This is also shown on the H1 display as a "28" error, Excessive Deviation. When this error occurs, the maximum deviation that was encountered is stored in parameter P-0-0098 in percent, with 100% = 360°.

A procedure for setting this parameter is as follows:

1) Set this parameter (S-0-0159, Monitoring Window) to 50%.
2) Run the axis with its maximum velocity and acceleration for the application.
3) Read the maximum model deviation from IDN P-0-0098.
4) Multiply the max. model deviation by 2 and enter into parameter S-0-0159.

Data Length:	2 bytes
Min. Input:	0
Max. Input:	6553.5
Units:	Percentage (100% = 360°)

S-0-0160 Scaling Options for Acceleration Data

A variety of acceleration scaling options can be selected for all acceleration data as described below:

Data Length: 2 bytes

```
15                 6 5 4 3 2 1 0
| 0 0 0 0 0 0 0 0 | 0 x 0 x x 0 x x |

                     | | | | | | |  Bit 2-0: Scaling Option
                     x 0 0 0 0 0 0 - no scaling
                     1 0 x x 0 0 1 - linear scaling
                     x 0 x x 0 1 0 - rotational scaling
                     | | | |
                     | | | |  Bit 3:
                     | | | 0 - preferred scaling
                     | | | 1 - parameter scaling
                     | | |
                     | | |  Bit 4: Units for linear scaling
                     | | 0 - meters [m]
                     | | 1 - inches [in]
                     | | |
                     | | |  Bit 4: Units for rotational scaling
                     | | 0 - radians [rad]
                     | | 1 - undefined
                     | |
                     | |  Bit 5: Time units
                     | 0 - second² [s²]
                     | 1 - undefined
                     |
                     |  Bit 6: Data reference
                     0 - At the motor shaft
                     1 - At the load
```

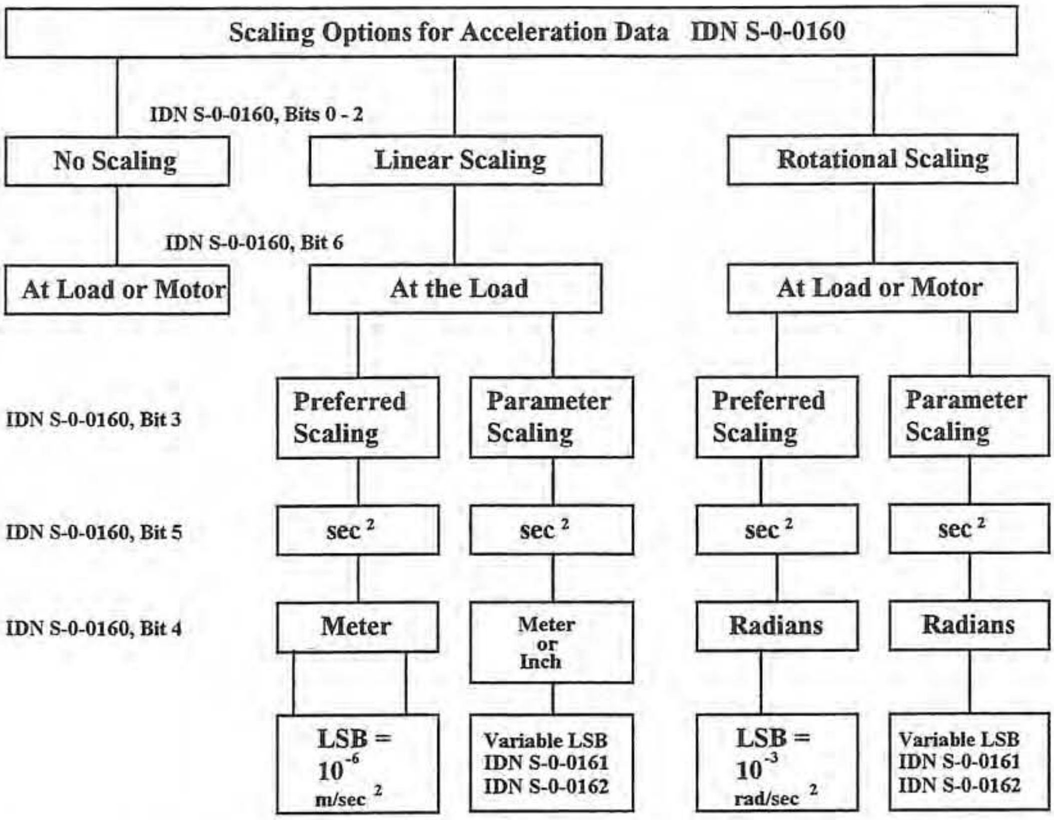
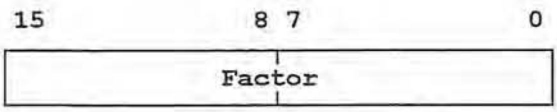


Figure 2.15 Scaling Options for Acceleration Data

S-0-0161 Scaling Factor for Acceleration Data

This ID Number contains the scaling factor that is to be used for scaling all acceleration data in the drive.

Data Length: 2 bytes
Min. Input: 1
Max. Input: 65535



S-0-0162 Scaling Exponent for Acceleration Data

This ID Number contains the scaling exponent that is to be used for scaling all acceleration data in the drive.

Data Length: 2 bytes
Min. Input: -32767
Max. Input: +32767

15	8 7	0
	Exponent	

Bit 15: Sign of Exponent
0 - positive
1 - negative

S-0-0165 Distance Coded Scale 1

When using a distance coded scale for measuring position, there are distance coded reference marks on the scale. This parameter contains the programmed value for the smallest distance between two reference marks for Distance Coded Scale 1.

Data Length: 4 bytes
Min. Input: 0
Max. Input: 2147483647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Linear = 1×10^{-7} m or 1×10^{-6} inches

S-0-0166 Distance Coded Scale 2

When using a distance coded scale for measuring position, there are distance coded reference marks on the scale. This parameter contains the programmed value for the smallest distance between two reference marks for Distance Coded Scale 2.

Data Length: 4 bytes
Min. Input: 0
Max. Input: 2147483647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Linear = 1×10^{-7} m or 1×10^{-6} inches

S-0-0169 Probe Control Parameter

The options in this parameter define the probe that will be active and which signal edges from the probe will indicate that the probe has been activated.

Data Length: 2 bytes

```
15                3 2 1 0
0 0 0 0 0 0 0 x   0 0 0 0 x x x x
```

Bit 0: Probe 1 positive edge
0 - positive edge is not active
1 - positive edge is active

Bit 1: Probe 1 negative edge
0 - negative edge is not active
1 - negative edge is active

Bit 2: Probe 2 positive edge
0 - positive edge is not active
1 - positive edge is active

Bit 3: Probe 2 negative edge
0 - negative edge is not active
1 - negative edge is active

S-0-0170 Probing Cycle Procedure Command

This command is used to set and enable the probing cycle. This procedure first requires that one of the probe enables, (Probe 1 Enable, IDN S-0-0405 or Probe 2 Enable, IDN S-0-0406), are set. The master then acts on the probe input which was selected. These inputs correspond with Probe 1 or 2, IDN's S-0-0401 or S-0-0402. The functionality of these inputs is programmed in IDN S-0-0169, Probe Control Parameter.

At the instant a probe is activated, the position is captured in the drive and stored in one of the probe position parameters, IDN's S-0-0130 to S-0-0133, depending on the Probe Control Parameter, IDN S-0-0169.

Once a probe measurement has taken place, the probing is disabled for the respective probe. If multiple sequential probe measurements are desired, the respective probe enable must be cycled to "0" then back to "1" between each probe measurement. (refer to Probe 1 Enable, IDN S-0-0405 or Probe 2 Enable, IDN S-0-0406).

Data Length: 2 bytes

```
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 x x |
                                | |
                                | 0 - Cancel command in drive
                                | 1 - Set command in drive
                                |
                                0 - Interrupt command execution
                                1 - Enable command execution
```

```
| 0 0 0 0 0 0 0 x | 0 0 0 0 x x x x |
                x           | | | |
                |           | | | 0 - Command not set in drive
                |           | | | 1 - Command set in drive
                |           | | |
                |           | | 0 - Command execution interrupt in drive
                |           | | 1 - Command execution enabled in drive
                |           | |
                |           | 0 - Command executed correctly
                |           | 1 - Command not yet executed
                |           |
                |           0 - No command error
                |           1 - Command execution not possible
                |
                0 - Valid operation data
                1 - Invalid operation data
```

S-0-0173 Marker Position A

During Homing, when a drive encounters the homing marker pulse of the position feedback (1 or 2), it stores the instantaneous unhomed position value in this parameter.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches

S-0-0177 Absolute Dimension Offset 1

This parameter describes the distance between the machine zero point and the zero point of the motor feedback with absolute dimension.

Data Length: 4 bytes
Min. Input: -2^{31}
Max. Input: $+2^{31} - 1$
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches

S-0-0178 Absolute Dimension Offset 2

This parameter describes the distance between the machine zero point and the zero point of the external feedback with absolute dimension.

Data Length: 4 bytes
Min. Input: -2^{31}
Max. Input: $+2^{31} - 1$
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches

S-0-0182 Manufacturer Class 3 Diagnostics

The DDS 2.1 contains special operation status diagnostics that are not contained in the SERCOS defined Class 3 Diagnostics, IDN S-0-0013. When bit 15 is set in Class 3 Diagnostics, the user is referred to this ID number for a further description of the operation status.

Data Length: 2 bytes

r r r r r x x x x x x x x x x x

Bit 4: Target position is outside of position limits
Target Pos. P-0-0049 > Positive Pos. Lim. S-0-0049 or
Target Pos. P-0-0049 > Negative Pos. Lim. S-0-0050
and Limit Values are enabled (bit 4 in S-0-0055 = 1)

Bit 5: Bipolar Velocity Limit Value is too high
|Bipolar Vel. Lim.| > |Calculated max. speed of the motor*|
* Calculated with feed constant and gear ratio

Bit 6: Target position is reached
Target position - Feedback position is within the position window, S-0-0057, and Cmd position - Fdbk position is within pos. window and
| Velocity Feedback | < Zero Velocity Window (S-0-00124)

Bit 11: Drive has halted
Bit 13 in the control = 0 and
| Velocity Feedback | < Zero Velocity Window (S-0-00124)

S-0-0185 Length of Configurable Data Record of the AT

This parameter indicates the maximum length in bytes that can be processed by the drive in the configurable data record of the AT. This parameter is used only if the custom telegram was selected in the Telegram Type Parameter, IDN S-0-0015.

Data Length: Variable, (even number of bytes)
Min. Input: 0
Max. Input: 65535

S-0-0186 Length of Configurable Data Record of the MDT

This parameter indicates the maximum length in bytes that can be processed by the drive in the configurable data record of the MDT. This parameter is used only if the custom telegram was selected in the Telegram Type Parameter, IDN S-0-0015.

Data Length: Variable, (even number of bytes)
Min. Input: 0
Max. Input: 65535

S-0-0187 List of Configurable Data of the AT

This list contains the ID numbers of the parameters that can be placed in the configurable data record of the AT. If placed in the AT configurable data record, this data will be transmitted every SERCOS cycle. This parameter is used only if the custom telegram was selected in the Telegram Type Parameter, IDN S-0-0015.

Data Length: Variable, (even number of bytes)

S-0-0188 List of Configurable Data of the MDT

This list contains the ID numbers of the parameters that can be placed in the configurable data record of the MDT. If placed in the MDT configurable data record, this data will be transmitted every SERCOS cycle. This parameter is used only if the custom telegram was selected in the Telegram Type Parameter, IDN S-0-0015.

Data Length: Variable, (even number of bytes)

2

S-0-0189 Following Error

This parameter displays the position following error or lag of the motor when the drive is operating in a closed position loop. The following error is defined as the difference between the command position value and the actual position value.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Type - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches

S-0-0192 List of Backup Operation Data

The ID numbers of all drive data that must be loaded in the drive in order to guarantee correct operation are stored in this list. The Master may then use this list to generate a backup copy of the drive parameters, (e.g. on a floppy disk).

Data Length: Variable, (even number of bytes)

S-0-0262 Load Default Gain Parameters - Procedure Command

By executing this procedure command, all standard gain parameters for the connected motor will be loaded and activated by the drive. The parameters that are affected are:

S-0-0100 - Velocity Loop Proportional Gain
S-0-0101 - Velocity Loop Integral Action Time
S-0-0104 - Position Loop Gain - (KV)
S-0-0106 - Current Loop Proportional Gain
P-0-0004 - Smoothing Time Constant

Data Length: 2 bytes

```
0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 x x
                              | |
                              | 0 - Cancel command in drive
                              | 1 - Set command in drive
                              |
                              0 - Interrupt command execution
                              1 - Enable command execution
```

```
0 0 0 0 0 0 0 x | 0 0 0 0 x x x x
              |           | | | |
              |           | | | 0 - Command not set in drive
              |           | | | 1 - Command set in drive
              |           | | |
              |           | | 0 - Command execution interrupt in drive
              |           | | 1 - Command execution enabled in drive
              |           | |
              |           | 0 - Command executed correctly
              |           | 1 - Command not yet executed
              |           |
              |           0 - No command error
              |           1 - Command execution not possible
              |
              0 - Valid operation data
              1 - Invalid operation data
```

S-0-0301 Allocation of Real Time Control Bit 1

In order to assign a signal to the real time control bit 1, the IDN of the signal is written to the operation data of this ID Number. After the allocation, the assigned signal appears in the real time control bit 1.

Data Length: 2 bytes
Min. Input: 0
Max. Input: 65535

S-0-0303 Allocation of Real Time Control Bit 2

In order to assign a signal to the real time control bit 2, the IDN of the signal is written to the operation data of this ID Number. After the allocation, the assigned signal appears in the real time control bit 2.

Data Length: 2 bytes
Min. Input: 0
Max. Input: 65535

S-0-0305 Allocation of Real Time Status Bit 1

In order to assign a signal to the real time status bit 1, the IDN of the signal is written to the operation data of this ID Number. After the allocation, the assigned signal appears in the real time status bit 1.

Data Length: 2 bytes
Min. Input: 0
Max. Input: 65535

S-0-0307 Allocation of Real Time Status Bit 2

In order to assign a signal to the real time status bit 2, the IDN of the signal is written to the operation data of this ID Number. After the allocation, the assigned signal appears in the real time status bit 2.

Data Length: 2 bytes
Min. Input: 0
Max. Input: 65535

S-0-0400 Home Switch

This parameter is used to assign an ID Number to the home switch. This allows the home switch to be allocated to a real time status bit, (See IDN S-0-0305). Bit 0 reflects the state of the home switch.

Data Length: 2 bytes

```
15                                 0
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x |
                                   |
                                   0 - Home Switch Not Active
                                   1 - Home Switch Active
```

S-0-0401 Probe 1

This parameter is used to assign an ID Number to the probe 1 switch. This allows the probe switch to be allocated to a real time control bit, (See IDN S-0-0301 and S-0-0303). Related parameters are IDN's S-0-0130 and S-0-0131.

The signal "Probe 1" is checked and updated by the drive only if the procedure command "Probing Cycle", IDN S-0-0170, is active and the signal "Probe 1 Enable", IDN S-0-0405, is set. Bit 0 reflects the state of the probe switch.

Data Length: 2 bytes

```
15                                 0
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x |
                                   |
                                   0 - Probe 1 Not Active
                                   1 - Probe 1 Active
```

S-0-0402 Probe 2

This parameter is used to assign an ID Number to the probe 2 switch. This allows the probe switch to be allocated to a real time control bit, (See IDN S-0-0301 and S-0-0303). Related parameters are IDN's S-0-0132 and S-0-0133.

The signal "Probe 2" is checked and updated by the drive only if the procedure command "Probing Cycle", IDN S-0-0170, is active and the signal "Probe 2 Enable", IDN S-0-0406, is set. Bit 0 reflects the state of the probe switch.

Data Length: 2 bytes

```
15                                 0
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x |
                                   |
                                   0 - Probe 2 Not Active
                                   1 - Probe 2 Active
```

S-0-0403 Position Feedback Status

When the drive's position feedback values are referenced to the coordinates defined by the machine zero point, the drive sets Bit 0 of this parameter in order to inform the control unit. Bit 0 will be reset during a drive controlled homing, or if the drive looses its reference to the machine zero point.

Data Length: 2 bytes

```
15                                 0
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x |
                                   |
                                   0 - Position not referenced to mach. zero point.
                                   1 - Position referenced to mach. zero point
```

S-0-0405 Probe 1 Enable

This parameter is used to assign an ID number to Probe 1 Enable. This allows the status "Probe 1 Enable" to be assigned to a real time control bit, (see IDN S-0-0301).

The signal "Probe 1 Enable" is checked and updated by the drive only if the procedure command "Probing Cycle", IDN S-0-0170, is active. For a repeated probing cycle on the same edge of probe 1, the control unit must reset this parameter to "0," then set it back to "1."

Data Length: 2 bytes

```
15                                0
0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x
                                  |
                                  0 - Probe 1 Not Enabled
                                  1 - Probe 1 Enabled
```

S-0-0406 Probe 2 Enable

This parameter is used to assign an ID number to Probe 2 Enable. This allows the status "Probe 2 Enable" to be assigned to a real time control bit, (see IDN S-0-0301).

The signal "Probe 2 Enable" is checked and updated by the drive only if the procedure command "Probing Cycle", IDN S-0-0170, is active. For a repeated probing cycle on the same edge of probe 2, the control unit must reset this parameter to "0," then set it back to "1."

Data Length: 2 bytes

```
15                                0
0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x
                                  |
                                  0 - Probe 2 Not Enabled
                                  1 - Probe 2 Enabled
```

2

S-0-0409 Probe 1 Positive Edge Latched

This parameter is used to assign an ID number to Probe 1 Positive Edge Latched. This allows the status "Probe 1 Positive Edge Latched" to be assigned to a real time status bit, (see IDN S-0-0305).

Bit 0 of this parameter is set by the drive only if the procedure command "Probing Cycle", IDN S-0-0170, is active; "Probe 1 Enable", IDN S-0-0405, is set to "1" and the positive edge of probe 1, IDN S-0-0401, has been detected. When this occurs, the drive simultaneously stores the position feedback value in "Probe 1 - Positive Edge Position Value", IDN S-0-0130.

The drive resets this bit when the control unit cancels the "Probing Cycle" procedure command, or when "Probe 1 Enable" is reset to "0".

Data Length: 2 bytes

```
15                                0
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x |
                                  |
                                  0 - Probe 1 positive not latched
                                  1 - Probe 1 positive latched
```

S-0-0410 Probe 1 Negative Edge Latched

This parameter is used to assign an ID number to Probe 1 Negative Edge Latched. This allows the status "Probe 1 Negative Edge Latched" to be assigned to a real time status bit, (see IDN S-0-0305).

Bit 0 of this parameter is set by the drive only if the procedure command "Probing Cycle", IDN S-0-0170, is active, "Probe 1 Enable", IDN S-0-0405, is set to "1" and the negative edge of probe 1, IDN S-0-0401 has been detected. When this occurs, the drive simultaneously stores the position feedback value in "Probe 1 - Negative Edge Position Value", IDN S-0-0131.

The drive resets this bit when the control unit cancels the "Probing Cycle" procedure command, or when "Probe 1 Enable" is reset to "0".

Data Length: 2 bytes

```
15                                0
|0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x|
                                  |
                                  0 - Probe 1 negative not latched
                                  1 - Probe 1 negative latched
```

S-0-0411 Probe 2 Positive Edge Latched

This parameter is used to assign an ID number to Probe 2 Positive Edge Latched. This allows the status "Probe 2 Positive Edge Latched" to be assigned to a real time status bit, (see IDN S-0-0305).

Bit 0 of this parameter is set by the drive only if the procedure command "Probing Cycle", IDN S-0-0170, is active; "Probe 2 Enable", IDN S-0-0406, is set to "1" and the positive edge of probe 2, IDN S-0-0402, has been detected. When this occurs, the drive simultaneously stores the position feedback value in "Probe 2 - Positive Edge Position Value", IDN S-0-0132.

The drive resets this bit when the control unit cancels the "Probing Cycle" procedure command, or when "Probe 2 Enable" is reset to "0".

Data Length: 2 bytes

```
15                                0
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x |
                                  |
```

0 - Probe 2 positive not latched
1 - Probe 2 positive latched

S-0-0412 Probe 2 Negative Edge Latched

This parameter is used to assign an ID number to Probe 2 Negative Edge Latched. This allows the status "Probe 2 Negative Edge Latched" to be assigned to a real time status bit, (see IDN S-0-0305).

Bit 0 of this parameter is set by the drive only if the procedure command "Probing Cycle", IDN S-0-0170, is active; "Probe 2 Enable", IDN S-0-0406, is set to "1" and the negative edge of probe 2, IDN S-0-0402, has been detected. When this occurs, the drive simultaneously stores the position feedback value in "Probe 2 - Negative Edge Position Value", IDN S-0-0133.

The drive resets this bit when the control unit cancels the "Probing Cycle" procedure command, or when "Probe 2 Enable" is reset to "0".

Data Length: 2 bytes

```
15                                  0
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x |
                                    |
                                    0 - Probe 2 negative not latched
                                    1 - Probe 2 negative latched
```

2.3. Description of the product specific parameters in the DDS 2.1

P-0-0004 Smoothing Time Constant

A time constant can be integrated into the Proportional gain of the Velocity loop regulator in order to suppress the quantization effects and limit the bandwidth of the velocity loop regulator. (See the block diagram of the velocity loop regulator.)

The smallest input value that can be used for this parameter is 250µsec. The filter is switched off for values smaller than this amount.

Data Length: 2 bytes
Min. Input: 250
Max. Input: 65535
Units: µsec
Access Mode: Read/Write in Phase 2 and Phase 4

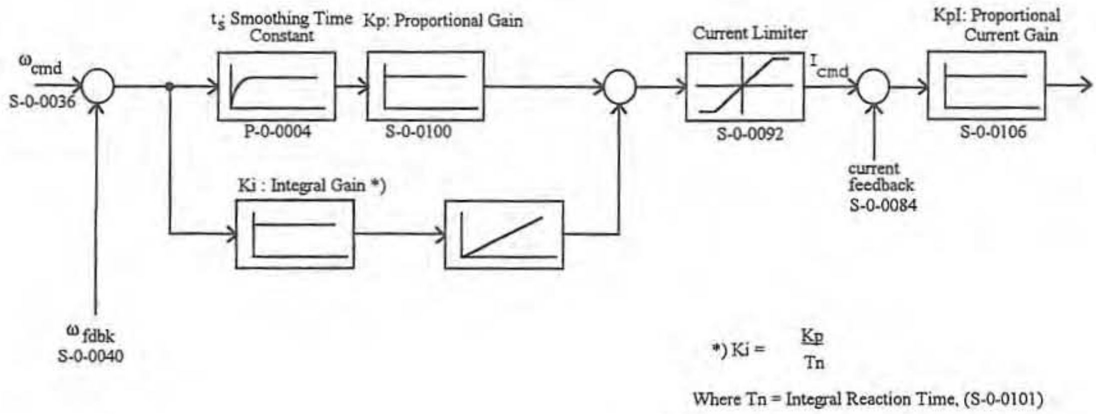


Figure 2.16 Velocity Loop Regulator

P-0-0005 Language Selection

All texts such as parameter descriptions, diagnostic messages, etc., are stored in several languages in the DDS 2.1. The languages in which these text messages can be displayed are selected by this parameter.

0: German
1: English

Data Length: 2 bytes
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0006 Overload Factor

The motor continuous current is derived from the Overload Factor as follows:

Motor Continuous Current = Nominal Motor Current x Overload Factor

The allowable motor continuous current is dependent on the application, (Duty Cycle). The corresponding value of the Overload Factor for a typical application can be taken from the drive selection list.

Data Length: 2 bytes
Min. Input:
Max. Input: 65535
Units: %
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

P-0-0007 Error Reaction

The way in which a drive reacts to a non-fatal error can be selected by this parameter. A non-fatal error is defined as a drive error which does not prevent the drive from being disabled at standstill.

0: At the appearance of a drive error, the drive, depending upon the present operation mode, switches to velocity loop regulation mode, forces a velocity command of 0 RPM and signals the power supply unit of a drive error via the ribbon cable (X1, pin 2). This forces the power supply to switch main power "OFF.". The drive continues to brake at its maximum deceleration rate and after 500 msec the drive enable, (RF), is switched off, leaving the motor in a torque free mode.

1: This Error Reaction is the same as Reaction 0 above, with the exception that no signal is sent to the power supply via the ribbon cable (X1, pin2).

2: When a non-fatal drive error occurs, the drive will immediately switch to a torque free mode. If a motor brake is used, the brake will immediately engage. The Bb contact on the drive will open. No signal will be sent to the power supply via the ribbon cable, (X1, pin2).

3: At the occurrence of a non-fatal drive error and with a still functional SERCOS communication, the drive will try to maintain normal operation for 30 sec. The corresponding error will immediately be sent to the control unit. The control unit then has the option to bring the system to a controlled stop. Once the 30 second operation time has elapsed, the drive will force a 0 RPM velocity command to bring the motor to a stop. After 500msec, the torque will be switched off of the motor and the Bb contact on the drive will open. No signal is sent to the power supply in this case.

Fatal Errors are:

- Feedback Errors
- Control (low) Voltage Errors
- Over Current
- Over Voltage

At the occurrence of these fatal errors, the drive will basically switch the current off. Simultaneously, the drive will signal the power supply the a drive error exists, via pin 2 on the X1 ribbon cable.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

P-0-0010 Excessive Position Command Value

All cyclic position command values that reach the drive via the SERCOS Interface are checked and compared with the previous command values to determine whether the new value is permissible. The new position value is determined to be acceptable when the difference between the present value and the previous value is less than or equal to the velocity limit value, (see IDN S-0-0091, Bipolar Velocity Limit Value). When the drive determines that there is an excessive position command value, it stores the excess value in this parameter. The reaction to this error is dependent on the error reaction stored in parameter P-0-0007. In addition, the last valid position command value is stored in parameter P-0-0011. With this error processing of an excessive position command, it is possible to completely reconstruct the condition leading to the error.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

P-0-0011 Last Valid Position Command Value

In the case of an excessive position command value, the last valid position command is stored in this parameter. (See P-0-0010, Excessive Position Command Value).

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches

Access Mode: Read in Phase 2 and Phase 4 (Read Only)

P-0-0012 Set Absolute Measuring Procedure Command

Indramat's Intelligent AC Servo Drives have an integrated absolute encoder function option. In order to set a fixed reference value for this integrated absolute encoder, the following procedure is employed:

The effected axis is moved to an exact known reference position which has been manually entered.

The desired position feedback value at the reference position is entered in Parameter S-0-0052, Position Feedback 1 - Reference Distance.

The procedure command, P-0-0012, is executed.

At the execution of the procedure command, if the drive finds that it is not in closed loop regulation, it will immediately take the value that it finds in parameter S-0-0052 as its position feedback value. (Controlled by comparing S-0-0051 to S-0-0052.)

At the execution of the procedure command, if the drive finds that it is in closed loop regulation, it will determine the reference point in relation to the position feedback value after switching on RF, or during execution of the Drive Controlled Homing Procedure, (S-0-0148).

Data Length: 2 bytes
Access Mode: May be activated in Phase 4

P-0-0014 Determine Marker Position - Procedure Command

During execution of this command, immediately after the marker pulse is encountered, the position feedback value, (from the external feedback), is stored in IDN S-0-0173, Marker Position.

Data Length: 2 bytes
Access Mode: Can be activated in Phase 4

P-0-0019 Starting Position Value

During the powering up of a SERCOS based system, the last valid position feedback value can be written to this parameter by the control unit over the SERCOS Interface. The drive then assumes this starting position value as its feedback value. This allows a travel of this axis for initial positioning if need be, with reduced precision.

If nothing is written to this parameter during Communication Phase 2, no new starting position value will overwrite the position feedback value. The feedback value is then absolute within one motor revolution.

If the drive is equipped with the integrated absolute encoder function, this parameter is not in effect, since such a drive continually has the exact absolute position information at its disposal.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4
Write in Phase 2

P-0-0020 Displacement of the Home Switch

During Drive Controlled Homing, the home switch is evaluated by the drive. An optimal location exists from the relative position where the home switch signals to the marker pulse of the motor encoder. In order to facilitate in the adjustment during the first start-up, the distance from the home switch dog to the ideal point can be displayed with this parameter. The value is dependent on the programmed position scaling type, (see S-0-0076), and is displayed in [mm] or [°].

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

P-0-0021 Oscilloscope Channel 1 - Acquired Data Samples

This parameter contains the acquired data samples representing the signal to be displayed in Channel 1. The data is in the SERCOS format and is represented by 32 bits for each sample.

Data Length: 4 bytes * number of samples
Min. Input: -214748.3647
Max. Input: +214748.3647
Units: Dependent on signal selection and scaling
Access Mode: Read in Phase 2 and Phase 4 (Read Only)

P-0-0022 Oscilloscope Channel 2 - Acquired Data Samples

This parameter contains the acquired data samples representing the signal to be displayed in Channel 2. The data is in the SERCOS format and is represented by 32 bits for each sample.

Data Length:	4 bytes * number of samples
Min. Input:	-214748.3647
Max. Input:	+214748.3647
Units:	Dependent on signal selection and scaling
Access Mode:	Read in Phase 2 and Phase 4 (Read Only)

P-0-0023 Oscilloscope Signal Selection - Channel 1

A number is entered into this parameter in order to select one of the signals from the list below as the signal to be recorded in Channel 1.

0: No Signal Recording
1: Position Feedback
2: Velocity Feedback
3: Velocity Deviation
4: Position Deviation
5: Torque Command Value

Data Length:	2 bytes
Access Mode:	Read/Write in Phase 2 and Phase 4

P-0-0024 Oscilloscope Signal Selection - Channel 2

A number is entered into this parameter in order to select one of the signals from the list below as the signal to be recorded in Channel 2.

0: No Signal Recording
1: Position Feedback
2: Velocity Feedback
3: Velocity Deviation
4: Position Deviation
5: Torque Command Value

Data Length:	2 bytes
Access Mode:	Read/Write in Phase 2 and Phase 4

P-0-0025 Trigger Source

If an internal or external signal is to trigger the start of the signal recording, the source must be defined in this parameter. The following selections are possible:

1: External triggering with the Real Time Bit in the Control Word of the drive initiating the start of the recording.

2: Internal triggering with the drive internally starting the recording. This is based on the trigger signal, threshold and delay.

Data Length: 2 bytes
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0026 Trigger Signal Selection

The triggering can be initiated by several signals from the list below:

1: Position Feedback
2: Velocity Feedback
3: Velocity Deviation
4: Position Deviation
5: Torque Command Value

Data Length: 2 bytes
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0027 Trigger Threshold for Position Data

This signal value, which corresponds to a position trigger signal (selected in P-0-0026), will trigger the start of the recording at the position level defined by this parameter. Parameter IDN P-0-0030 defines how this triggering will take place.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0028 Trigger Threshold for Velocity Data

This signal value, which corresponds to a velocity trigger signal (selected in P-0-0026), will trigger the start of the recording at the velocity level defined by this parameter. Parameter IDN P-0-0030 defines how this triggering will take place.

Data Length: 4 bytes
Min. Input: -2147483.647
Max. Input: +2147483.647
Units: Dependent on velocity scaling
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0029 Trigger Threshold for Torque Data

This signal value, which corresponds to a torque trigger signal (selected in P-0-0026), will trigger the start of the recording at the torque level defined by this parameter. Parameter IDN P-0-0030 defines how this triggering will take place.

Data Length: 2 bytes
Min. Input: -3276.7
Max. Input: +3276.7

Units: %
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0030 Trigger Mode

This parameter determines the signal behavior that will activate the trigger. The following selections are possible:

1: Trigger threshold is activated when it is reached by the signal level in the positive direction.
2: Trigger threshold is activated when it is reached by the signal level in the negative direction.
3: Trigger threshold is activated when it is reached by the signal level in the positive or negative direction.

Data Length: 2 bytes
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0031 Signal Sample Time (Time Divisions)

The sampling of the signal can only take place at discrete time points with the Oscilloscope Function. This sample time can be selected via this parameter. The valid sampling times are limited to integer multiples of the base scan time of 250 µsec.

Data Length: 2 bytes
Min. Input: 250
Max. Input: 8192000
Units: µsec
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0032 Oscilloscope Signal Memory Allocation

The DDS 2.1 Oscilloscope function can store 2 channels of sampled data. The distribution of memory for these signals is defined by this parameter. The range is from 1 to 2048 bytes, or 512 samples per channel. Two channels are allowed per drive.

Data Length: 2 bytes
Min. Input: 1 / channel
Max. Input: 2048 / channel
Units: Bytes

Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0033 Number of Samples After the Start of the Recording

The relative position of the trigger time point inside the recording memory is set with this parameter. This makes it possible to capture the portion of the signal that occurs before the trigger event. This function corresponds to that of a trigger delay of a typical oscilloscope. The adjustment range is between 0 and the memory size of the display memory. For example, with an adjustment value of 0, the trigger event would occur at the left edge of the oscilloscope screen.

Data Length: 2 bytes
Min. Input: 2
Max. Input: 512
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0035 Trigger Offset

The trigger offset determines the number of samples between the occurrence of the trigger event and the start of recording.

Data Length: 2 bytes
Min. Input: 0
Max. Input: 65535
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0036 Trigger Control Word

Start Recording:

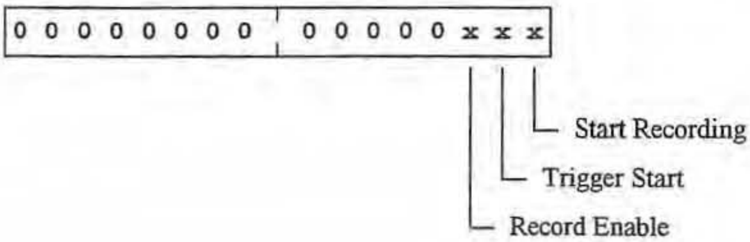
This bit allows the control to synchronize acquisition between several drives without using a Real Time Bit. The recording of the data starts the instant that this bit is set to "1."

Trigger Start:

The internal trigger mechanism is activated when the Trigger Start bit is set to "1."

Record Enable:

Data acquisition is enabled by this bit in all situations. For internal triggering, the drive sets this bit to "0" once the sampled data buffer is full. In cases where a trigger delay is implemented using an external trigger, some data is captured before the trigger event occurs. The data acquisition must begin first for an adequate length of time before setting this bit.



Data Length: 2 bytes
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0037 Trigger Status Word

In the case where several drives are capturing synchronized data to be triggered off of one drive, (see trigger modes), the data acquisition must be simultaneously activated. This trigger activation is signaled to the control via the bit "Trigger Activated" bit. The data acquisition is then initiated by the control by setting the real time bits "Start Recording" on all drives simultaneously.

Data Acquisition in Progress :

This bit is set to "1" whenever the sample buffer is being filled. It is set to "0" when the trigger or delay condition has not occurred, or when the sample buffer is full.

Signal Lower Than Threshold:

This bit is set to "1" when the internal trigger signal is lower than the trigger threshold.

Trigger Activated:

This bit is set to "1" when the internal trigger is activated. In cases where several drives are capturing synchronized data to be triggered off of one drive (see trigger modes), the data acquisition must be simultaneously activated. When this bit is set, the control can notify the other drives of the trigger condition in one drive by immediately setting the "Start Recording" bit in Parameter P-0-0036, or by setting a Real Time Control Bit.

```
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 x x x |
                              | | |
                              | | └─ Trigger Activated
                              | └─ Signal Lower Than Threshold
                              └─ Data Acquisition in Progress
```

Data Length: 2 bytes
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0038 Signal Selection of the Analog Monitor Output - Channel 1

Two analog monitor outputs are provided on the DDS 2.1 so that drive internal signals can be output for test purposes. The parameter "Analog Output Channel 1" allows a signal to be selected out of a number of available signals to be output.

The following signals may be selected:
0: No analog output on Channel 1
1: Current command value (10V = Rated Current)
2: Velocity feedback value
3: Velocity command value
4: Position command value between 2 control unit cycles
5: Position feedback value 1 (motor encoder)
6: Position feedback value 2 (external encoder)
7: Position following error
8: Motor encoder sinusoidal signal
9: Motor encoder cosinusoidal signal
10: External encoder sinusoidal signal
11: External encoder cosinusoidal signal

Data Length: 2 bytes
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0039 Signal Selection for Analog Monitor Output - Channel 2

Two analog monitor outputs are provided on the DDS 2.1 so that drive internal signals can be output for test purposes. The parameter "Analog Output Channel 2" allows a signal to be selected out of a number of available signals to be output.

The following signals may be selected:
0: No analog output on Channel 2
1: Current command value (10V = Rated Current)
2: Velocity feedback value
3: Velocity command value
4: Position command value between 2 control unit cycles
5: Position feedback value 1 (motor encoder)
6: Position feedback value 2 (external encoder)
7: Position following error
8: Motor encoder sinusoidal signal
9: Motor encoder cosinusoidal signal
10: External encoder sinusoidal signal
11: External encoder cosinusoidal signal

Data Length: 2 bytes
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0040 Scaling of Velocity Data on the Analog Monitor Output - Chan. 1

Two analog monitor outputs are provided on the DDS 2.1 so that drive internal signals can be output for test purposes. When velocity data is selected to be output on the Analog Output - Channel 1, this parameter determines how that velocity data will be scaled. The output velocity is in respect to the motor shaft.

Data Length: 2 bytes
Min. Input: 0
Max. Input: 65535
Units: RPM/10V
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0041 Scaling of Velocity Data on the Analog Monitor Output - Chan. 2

Two analog monitor outputs are provided on the DDS 2.1 so that drive internal signals can be output for test purposes. When velocity data is selected to be output on the Analog Output - Channel 2, this parameter determines how that velocity data will be scaled. The output velocity is in respect to the motor shaft.

Data Length:	2 bytes
Min. Input:	0
Max. Input:	65535
Units:	RPM/10V
Access Mode:	Read/Write in Phase 2 and Phase 4

P-0-0042 Scaling of Position Data on the Analog Monitor Output - Chan. 1

Two analog monitor outputs are provided on the DDS 2.1 so that drive internal signals can be output for test purposes. When position data is selected to be output on the Analog Output - Channel 1, this parameter determines how that position data will be scaled. The output position is in respect to the motor shaft.

Data Length:	2 bytes
Min. Input:	0.00
Max. Input:	655.35
Units:	°/10V
Access Mode:	Read/Write in Phase 2 and Phase 4

P-0-0043 Scaling of Position Data on the Analog Monitor Output - Chan. 2

Two analog monitor outputs are provided on the DDS 2.1 so that drive internal signals can be output for test purposes. When position data is selected to be output on the Analog Output - Channel 2, this parameter determines how that position data will be scaled. The output position is in respect to the motor shaft.

Data Length:	2 bytes
Min. Input:	0.00
Max. Input:	655.35
Units:	°/10V
Access Mode:	Read/Write in Phase 2 and Phase 4

P-0-0045 IDN List of Control Dependent Application Parameters

This list provides a means to classify group parameters and can be used by a control to display parameters in the form of groups.

Access Mode: Read in Phase 2 and Phase 4

P-0-0046 IDN List of Machine Dependent Application Parameters

This list provides a means to classify group parameters and can be used by a control to display parameters in the form of groups.

Access Mode: Read in Phase 2 and Phase 4

P-0-0047 IDN List of Drive Parameters

This list provides a means to classify group parameters and can be used by a control to display parameters in the form of groups.

Access Mode: Read in Phase 2 and Phase 4

P-0-0048 IDN List of Gain Adjustment Parameters

This list provides a means to classify group parameters and can be used by a control to display parameters in the form of groups.

Access Mode: Read in Phase 2 and Phase 4

2

P-0-0049 Target Position

During the DDS 2.1 operation mode, Single Axis Mode, this parameter contains the target position to which the axis will travel.

Data Length: 4 bytes
Min. Input: -214748.3647
Max. Input: +214748.3647
Scaling: Scaling Options - IDN S-0-0076
Scaling Factor - IDN S-0-0077
Scaling Exponent - IDN S-0-0078
Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:
Rotational = 1×10^{-4} degrees
Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0050 Proportional Gain Acceleration Feed Forward

Acceleration feed forward can be achieved when the drive is in position loop mode with this parameter. This is done by commanding an acceleration jump derived from the position command value.

The feed forward gain is calculated as follows:

$$K_A = \frac{J_m + J_L}{K_T} \times 100$$

Where: K_A = Proportional gain acceleration feed forward $\left[\frac{\text{mA sec}^2}{\text{rad}}\right]$

Jm = Rotor inertia $\left[\text{in - lb - sec}^2\right]$

J_L = Reflected inertia after gear reduction $\left[\text{in - lb - sec}^2\right]$

Km = Motor torque constant $\left[\frac{\text{in - lb}}{\text{A}}\right]$

Data Length: 2 bytes
Min. Input: 0.0
Max. Input: 120.0
Units: mA/rad/sec^2
Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0051 Torque Constant

The torque constant of the connected motor is stored in the feedback, and can be displayed or viewed via this parameter. (Divide values in in-lbf by 8.85)

Data Length: 2 bytes
Min. Input: 0.00
Max. Input: 21474836.47
Units: Nm/A
Access Mode: Read in Phase 2 and Phase 4

P-0-0055 Axis Error Compensation - Status

This parameter is for the actual status of the compensation. In this parameter, all important information about initialization is updated and can be requested from the drive by the control unit. In addition, the control bit for the activation of Axis Error Compensation is included.

Data Length: 2 bytes
Access Mode: Read in Phase 2 and Phase 4

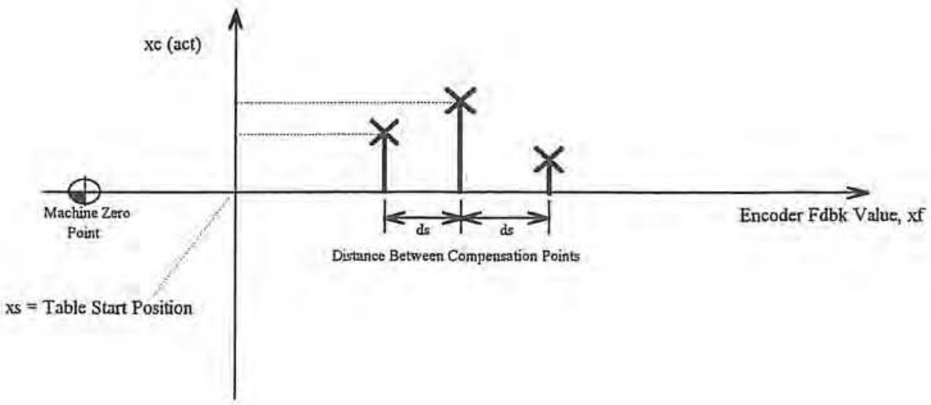


Figure 2.17 Diagram showing status of axis-error compensation

Structure of IDN P-0-0055:

x x x x x x x x | x x x x x x x x

- Bit 0: Axis Error Comp. active
- Bit 4: ds too small
- Bit 5: ds too large
- Bit 6: xs too large
- Bit 7: Interpolation Factor too large
- Bit 8: xs invalid
- Bit 9: ds invalid
- Bit 10: xc tables invalid
- Bit 11: reserved
- Bit 12: xs not initialized
- Bit 13: ds not initialized
- Bit 14: xc table not initialized
- Bit 15: reserved

P-0-0056 Distance Between Axis Correction Points

This parameter defines the distance between two compensation points. This can only be entered in the 32 bit preferred scaling mode and must correspond with the Correction Table Start Position and the correction table size.

The distance between correction points can be calculated as the total distance in which the axis error compensation is to be applied, (in mm), and dividing by 498. The largest correction value allowed is 3.27 mm.

Data Length:	4 bytes
Min. Input:	0.0001
Max. Input:	214748.3647
Units:	mm
Access Mode:	Read/Write in Phase 2 and Phase 4

P-0-0057 Correction Table Start Position

This parameter defines the distance between the Table Start Position and the machine zero point. The table start position is always the smallest position feedback value in the correction table, (see figure 3). The input can only be entered in preferred scaling (32 bit), where by the start position must always correspond with the correction value table.

Data Length:	4 bytes
Min. Input:	-214748.3647
Max. Input:	+214748.3647
Units:	mm
Access Mode:	Read/Write in Phase 2 and Phase 4

P-0-0058 Table of Correction Values

Two correction value tables, (one for each direction), are contained in this parameter. It is configured in a variable length list with an even number of bits. The correction values 1-500 are reserved for positive velocity commands, whereas the values 501-1000 correspond with negative command values.

Data Length:	4 bytes
Min. Input:	-214748.3647
Max. Input:	+214748.3647
Units:	mm

Access Mode: Read/Write in Phase 2 and Phase 4

P-0-0081 Parallel Output

When a parallel I/O card, DEA 4.1, is plugged into the drive, the status of the output channels can be viewed, displayed or set via this parameter.

Data Length: 2 bytes
Access Mode: Read/Write in Phase 4

P-0-0082 Parallel Input

When a parallel I/O card, DEA 4.1, is plugged into the drive, the status of the input channels can be viewed, displayed or obtained for processing via this parameter.

Data Length: 2 bytes
Access Mode: Read in Phase 4

P-0-0095 Position Command Interpolation at MDT Failure

If an MDT is missing or contains an invalid position command value, the drive will interpolate to derive the missing command value. Bit 1 activates or deactivates this function.

Data Length: 2 bytes
Access Mode: Read in Phase 4

```
15                                0
| 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 x |
                                  |
                                  0 - Cmd. Interpolation not active
                                  1 - Cmd. Interpolation active
```

Note:
Implementing the interpolation results in a delay of the position command value from the control unit cycle. When updating software, all axes that participate in the path interpolation must also be updated to this software revision. When combining S01.09 software with older software, this function must be switched off to avoid path errors.

P-0-0097 Absolute Encoder Monitoring Window

When an axis with an absolute feedback is powered down, the DDS 2.1 stores the position read from the feedback. When the system is powered back up, the drive checks the position of the motor and compares with the position that was stored before the power down. If the difference is greater than that stored in this parameter, Absolute Encoder Monitoring Window, an error "76" is shown on the H1 diagnostic display.

Data Length:	4 bytes
Min. Input:	0
Max. Input:	214748.3647
Scaling:	Scaling Options - IDN S-0-0076
	Scaling Factor - IDN S-0-0077
	Scaling Exponent - IDN S-0-0078
	Rotational Position Resolution - IDN S-0-0079
Preferred Scaling:	
	Rotational = 1×10^{-4} degrees
	Linear = 1×10^{-7} m or 1×10^{-6} inches
Access Mode:	Read in Phase 2 and Phase 4
	Write in Phases 2, 3 and 4

2

P-0-0098 Maximum Model Deviation

A drive model is implemented in the DDS in order to monitor the drive internal position loop. The difference between the position feedback value and the model feedback value produces an error signal. A threshold that limits the amount of excessive error which the system may exhibit is set in IDN S-0-0159, Monitoring Window. This is entered in percentage, with 100% = 360° of the motor shaft.

Complete parameterization of the model function can be accomplished in IDN S-0-0159. In this parameter Maximum Model Deviation can be activated. It is used in the following way:

First, the monitoring window is set to 50%. Then the corresponding axis is moved with at the designated velocity and acceleration for that axis. (For best results, a normal operating cycle should be executed taking into account typical loads.)
After this, the derived value can be read in the parameter Maximum Model Deviation.

A complete value for the monitoring window can be defined with the help of these deviation values, and the determined value can be provided in the Monitoring Window parameter with a safety factor of 1.5 to 2.

Data Length:	2 bytes
Min. Input:	0.0
Max. Input:	6553.5
Units:	%
Access Mode:	Read/Write in Phase 2 and Phase 4

P-0-0099 Position Command Value Smoothing Filter Time Constant

When operating in position loop mode, filtering of the position command value can be accomplished. The time constant of command value filter is set by this parameter. A time constant of "0" means that the filter is switched off.

Data Length:	2 bytes
Min. Input:	0.00
Max. Input:	655.35
Units:	Nm/A
Access Mode:	Read in Phase 2 and Phase 4

P-0-0106 Jerk Limit Value - Bipolar

During the DDS 2.1 operation mode, Single Axis Mode, this parameter contains the maximum allowable change of acceleration. The axis may not exceed this value during a move.

Data Length:	4 bytes
Min. Input:	0.000
Max. Input:	2147483.647
Units:	Dependent on acceleration scaling
Access Mode:	Read/Write in Phase 2 and Phase 4

P-0-0107 Slave Version

Version of the DDS 2.1 SERCOS Interface Module (DSS module) Firmware.

Data Length:	Variable in 1 byte increments, (ASCII characters)
Access Mode:	Read in Phase 2 and Phase 4

2.4. DDS 2.1 SERCOS Interface Functions

This section gives an overview of certain SERCOS functions as they apply to the DDS 2.1 drive. These functions are described at the SERCOS level. Many of these functions may already be implemented in the control unit being used. In this case, many of the details described in this section may be transparent to the user, and it is advised to refer to the control unit documentation for information on how to use these functions.

2.4.1. Axis Error Compensation

The Axis Error Compensation is used to compensate for systematic errors within a gearbox and lead screw by operating a closed position loop with the motor encoder as well as with a second encoder coupled directly to the load. In addition a highly accurate position must be measured when initially setting up this compensation. This is often provided with a highly accurate measuring system such as a laser inferrometer. The position error (i.e., compensation value), can be calculated and set by subtracting the position measured by the encoder from the correct position value, therefore providing a correction of the position. If it is impossible to measure the entire screw, point for point, the measurements should be taken at defined distance intervals. The correction values are linearly interpolated between the individual measurement points, providing an approximate compensation between these points.

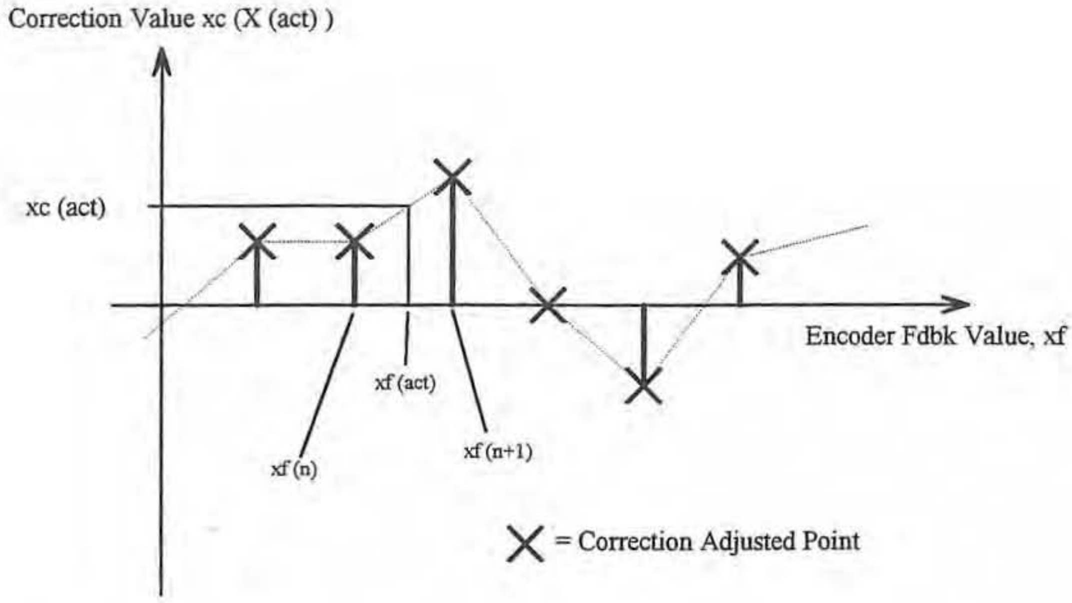


Figure 2.18 Correction Behavior

It follows that the True Position can be derived from the Encoder Feedback Position + Compensation Value. A gearbox with backlash in which motion in opposite directions occurs can also be taken into account. Correction values for both positive and negative directions are necessary, which, by taking the velocity command value of the slide into account, serves to generate the true position feedback value.

X (act) = xf (act) + xc (act), ; xcmd < xf (act) < (xcmd + 499 * ds)
X (act) = xf (act) ; [xf (act) < xcmd] or [xf (act) > (xcmd + 499 * ds)

Figure 2 shows a block diagram that represents the true position calculation within the drive.

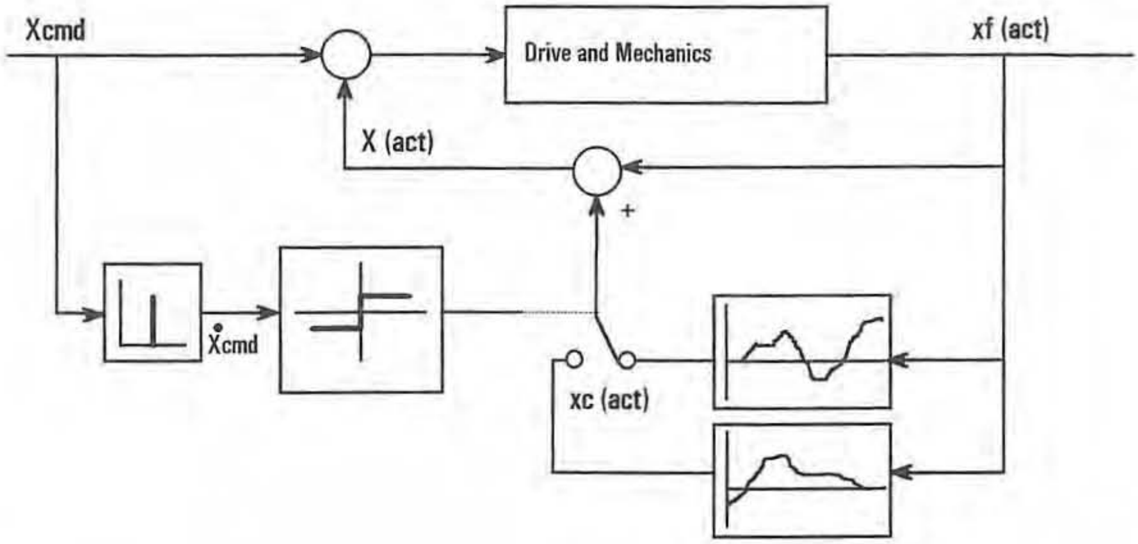


Figure 2.19 Axis Error Compensation Block Diagram

Theory of the Determination of the Correction Feedback Value - xc(x(act))

Methods of linear interpolation are applied in order to determine the Correction Feedback Value. This means that a straight line can be made between two correction sample points, and based on this the immediate correction value can be approximately determined. Therefore, the xc (act) value becomes the average of the linear equations from the actual correction sample points. This is shown as follows:

Linear Equation $$xc\,(act) = \frac{xc\,(n+1) - xc\,(n)}{ds} * [\, xf(act) - xf\,(n)\,] + xc\,(n)$$

It follows that the coordinate system would be shifted by x(n) respectively, whereby avoiding the count range limit by calculating the ordinate intercept point. The slope of the line, i.e., the expression [(xc(n+1)-xc(n)]/ds proves to be the interpolation factor.

Axes Error Compensation Specification

In order to implement axes error compensation, the following restrictions must be met:

2

1. There must be two correction tables, (one for each direction of motion), with 500 correction values, "xc," each, which are accessed from the EEPROM in the SERCOS format. In order to save memory, only 16 bit correction values will be allowed.

2. The most only a fixed range must be corrected, defined by a table start position "xs," which is entered as a 32 bit word in the EEPROM (in the SERCOS format). This sets the negative limit of the compensation range with reference to the machine zero point.

3. The sampling distance, "ds," defines the distance between two encoder feedbacks, which corresponds with the correction values.

4. The access of the respective correction value table depends on the polarity of the commanded velocity, d(Xcmd)/dt.

5. Encoder feedback values outside of the compensation range, defined by the start position and the distance between correction points, will not be compensated for.

6. The correction values can be viewed immediately via the SERCOS Interface as well as the RS-232 interface on the drive. The tables are stored on the resident DSM module so that these values can be easily transferred over to a new drive if replacement of the DDS is necessary.

7. All position data for axis error compensation may only be entered in preferred scaling. The maximum allowed correction value is ±3.27mm.

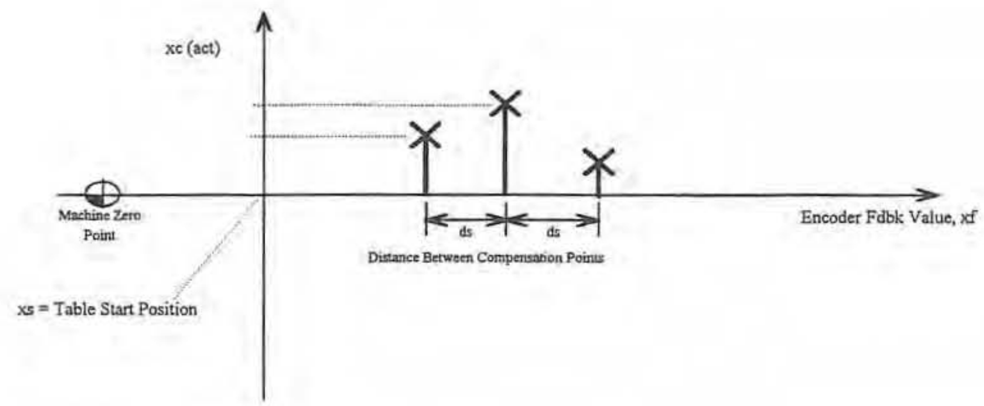


Figure 2.20 Description of Parameters

Axis Error Compensation Parameters

P-0-0055 Axis Error Compensation - Status

This parameter is for the actual status of the compensation. In this parameter, all important information about initialization is updated and can be requested from the drive by the control unit. In addition, the control bit for the activation of Axis Error Compensation is included.

```
x x x x x x x x | x x x x x x x x
```

- **Bit 0: Axis Error Comp. active**
- **Bit 4: ds too small**
- **Bit 5: ds too large**
- **Bit 6: xs too large**
- **Bit 7: Interpolation Factor too large**
- **Bit 8: xs invalid**
- **Bit 9: ds invalid**
- **Bit 10: xc tables invalid**
- **Bit 11: reserved**
- **Bit 12: xs not initialized**
- **Bit 13: ds not initialized**
- **Bit 14: xc table not initialized**
- **Bit 15: reserved**

2

P-0-0056 Distance Between Axis Correction Points

This parameter defines the distance between two compensation points. This can only be entered in the 32 bit preferred scaling mode and must correspond with the Correction Table Start Position and the correction table size.

The distance between correction points can be calculated as the total distance in which the axis error compensation is to be applied, (in mm), and dividing by 498. The largest correction value allowed is 3.27 mm.

P-0-0057 Correction Table Start Position

This parameter defines the distance between the Table Start Position and the machine zero point. The table start position is always the smallest position feedback value in the correction table, (see figure 3). The input can only be entered in preferred scaling (32 bit), where by the start position must always correspond with the correction value table.

P-0-0058 Table of Correction Values

Two correction value tables, (one for each direction), are contained in this parameter. It is configured in a variable length list with an even number of bits. The correction values 1-500 are reserved for positive velocity commands, whereas the values 501-1000 correspond with negative command values.

2.4.2. Single Axis Motion

Single Axis Motion allows the DDS 2.1 to perform a move independently of the rest of the system. This means that the control unit does not need to continually update the drive with control loop commands every cycle. Five parameters are pre configured in the drive that define the desired motion. The figure below gives a pictorial description of the Single Axis Motion function.

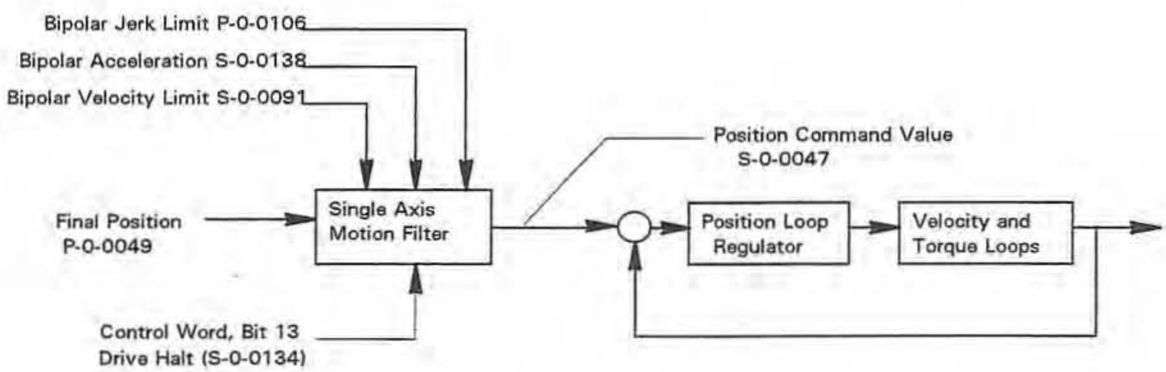
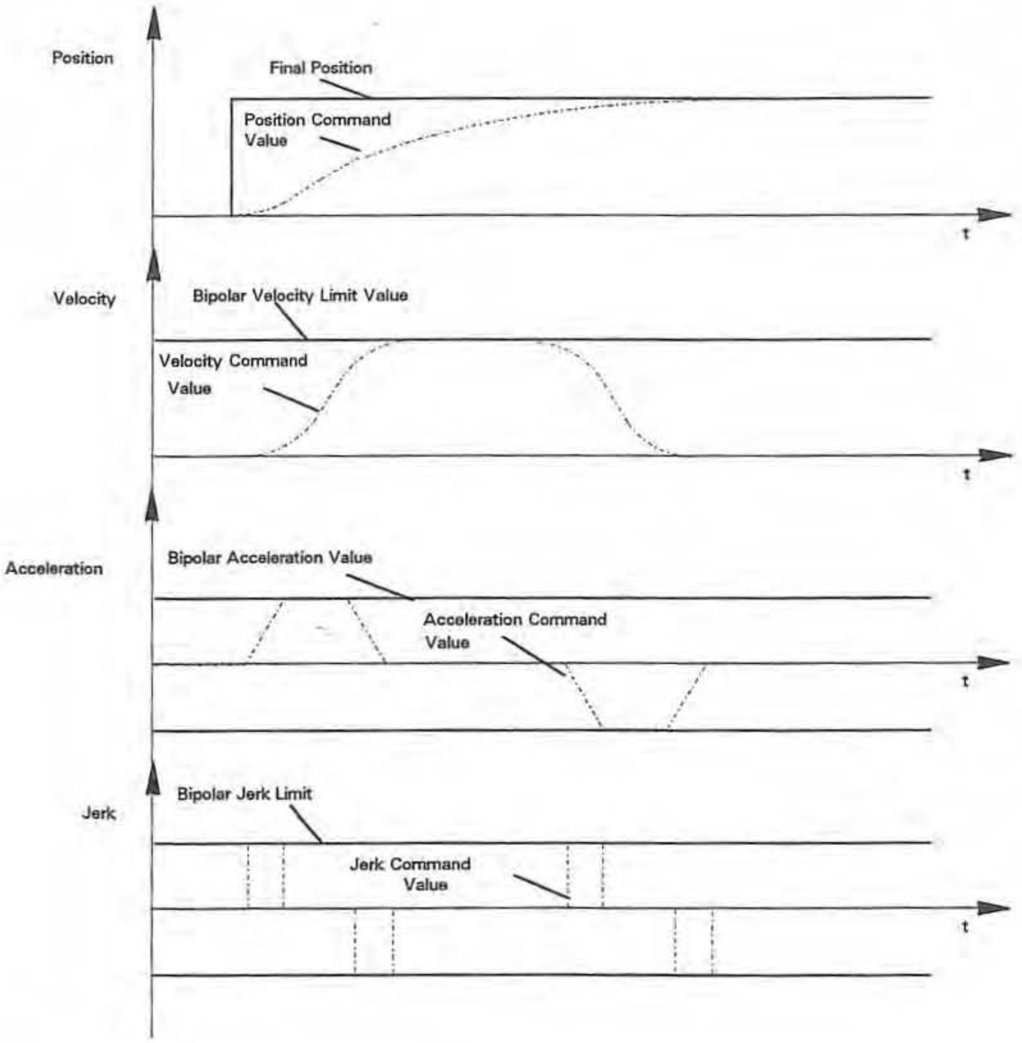


Figure 2.21 Single Axis Motion Function

When performing the single axis motion, the motor will accelerate at the rate described by IDN S-0-0138, to a velocity described by S-0-0091, and with a Jerk value described by P-0-0106. The drive will also internally calculate when to start its deceleration so that it stops at the final position defined by P-0-0049. These parameters are normally set before the procedure is executed, and bit 13 of the control word acts as a "GO" command. (This is done by removing the drive halt state.) Any of the above parameters can be changed at any time during the move and the axis will make immediate adjustments to follow the new changes to the best of its ability.



P-0-0106 Jerk Limit Value - Bipolar

During the DDS 2.1 operation mode, Single Axis Mode, this parameter contains the maximum allowable change of acceleration. The axis may not exceed this value during a move.

S-0-0138 Bipolar Acceleration

The bipolar acceleration parameter reduces the maximum acceleration ability of the drive symmetrically around 0, to the programmed value in both directions.

S-0-0091 Bipolar Velocity Limit Value

The bipolar velocity limit value determines the maximum allowable speed in either direction. If the velocity limit value is exceeded, the drive responds by setting the message "$n_{command} > n_{limit}$" in Class 3 Diagnostics (IDN S-0-0013).

P-0-0049 Target Position

During the DDS 2.1 operation mode, Single Axis Mode, this parameter contains the target position to which the axis will travel to.

2.4.3. Drive Controlled Homing

When the axes are first switched on and they have no absolute position orientation, the axes position measuring systems must be aligned so that they have a relationship to a known machine position before normal measuring operations take place. These alignments take place during the Homing Procedure.

In the past, homing has been done by the control unit. Since the position loop can be closed in the DDS 2.1, it has the ability to perform a drive controlled homing procedure. This function operates according to the SERCOS Interface specification.

The following example will illustrate the operation of the real time bits in a probing application:

Example 1:

In this example, the motor encoder will be used as the position feedback during the homing cycle. A marker pulse is generated by the feedback every motor revolution. When homing takes place, the motor will run at a preset homing velocity until it the axis encounters the home switch. For a typical homing application, the axis will continue and position to the next marker pulse for a more accurate home position. (It is possible to home directly to the home switch if desired when using the DDS 2.1.)

In this first example, the reference offset, (IDN S-0-0150), is set to "0."

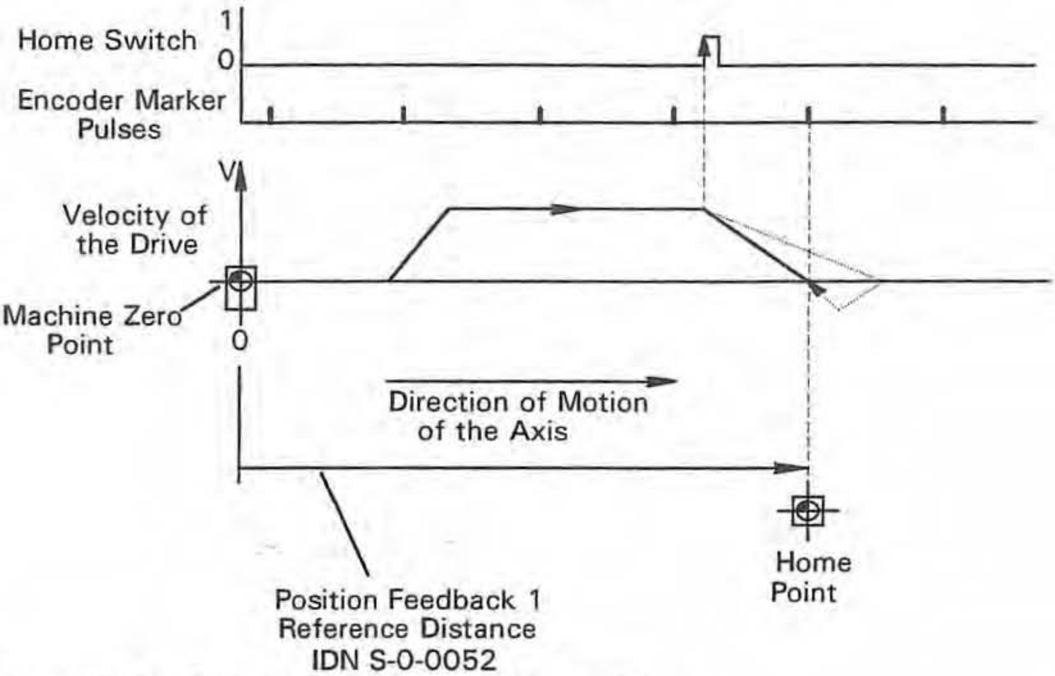


Figure 2.22 Homing Procedure using the Motor Feedback

Note that in the figure above, the home point is the first marker pulse after the home switch. The actual position of the home point is equal to the Position Feedback 1, Reference Distance, IDN S-0-0052. This means that the home switch can be set at some position other than the machine zero point. After homing is done, the axis can be commanded to move to machine zero if desired.

Example 2:

This example is the same as Example 1 above, except that the Reference Offset is set to a positive value. In this case, the drive encounters the home switch and looks for the following marker pulse. From this marker pulse, it continues to move in the same direction until it travels the distance of the Reference Offset. When it reaches its destination, the axis is considered to be at its home point and the position is set at the value in Position Feedback 1 - Reference Distance, (IDN S-0-0052).

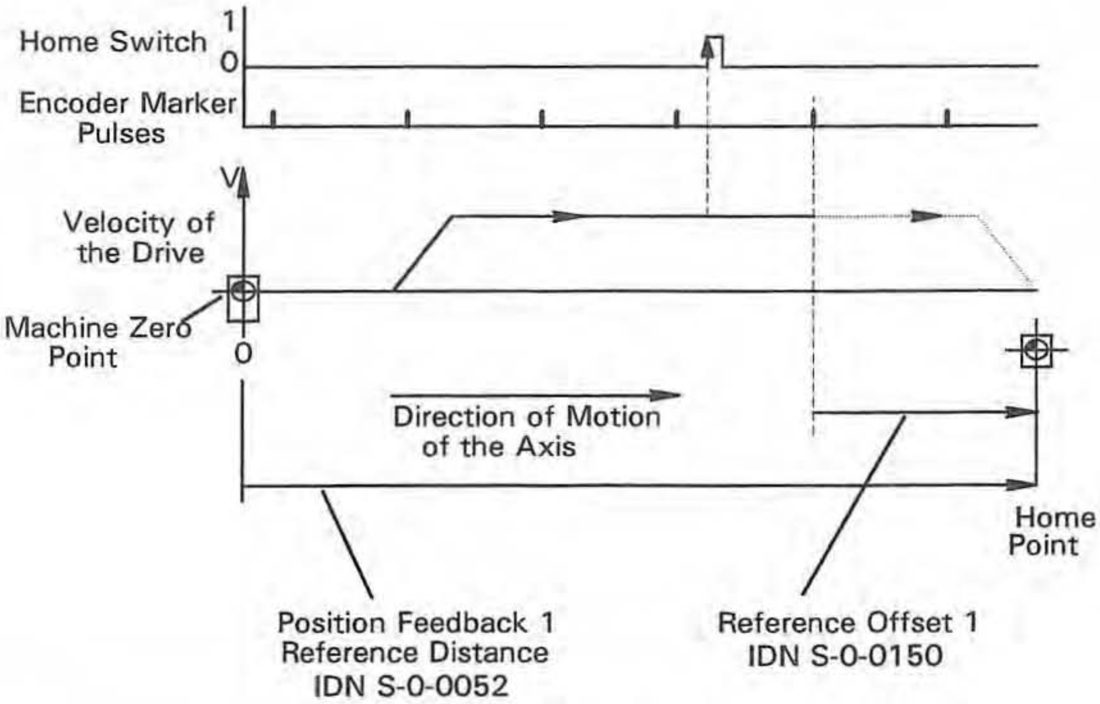


Figure 2.23 Homing Procedure with a Positive Reference Offset Value

Example 3:

This example is the same as Example 2 above, except that the Reference Offset is set to a negative value. In this case, the drive encounters the home switch and immediately reverses its direction. Since the axis references everything from the marker after the home switch during homing, and since the axis reversed direction before it saw this marker, it internally calculates its distance from the marker before the home switch. Now it must also add one motor revolution (the distance between markers), to its calculation of the offset position.. When it reaches its destination, the axis is considered to be at its home point and the position is set at the value in Position Feedback 1 - Reference Distance, (IDN S-0-0052).

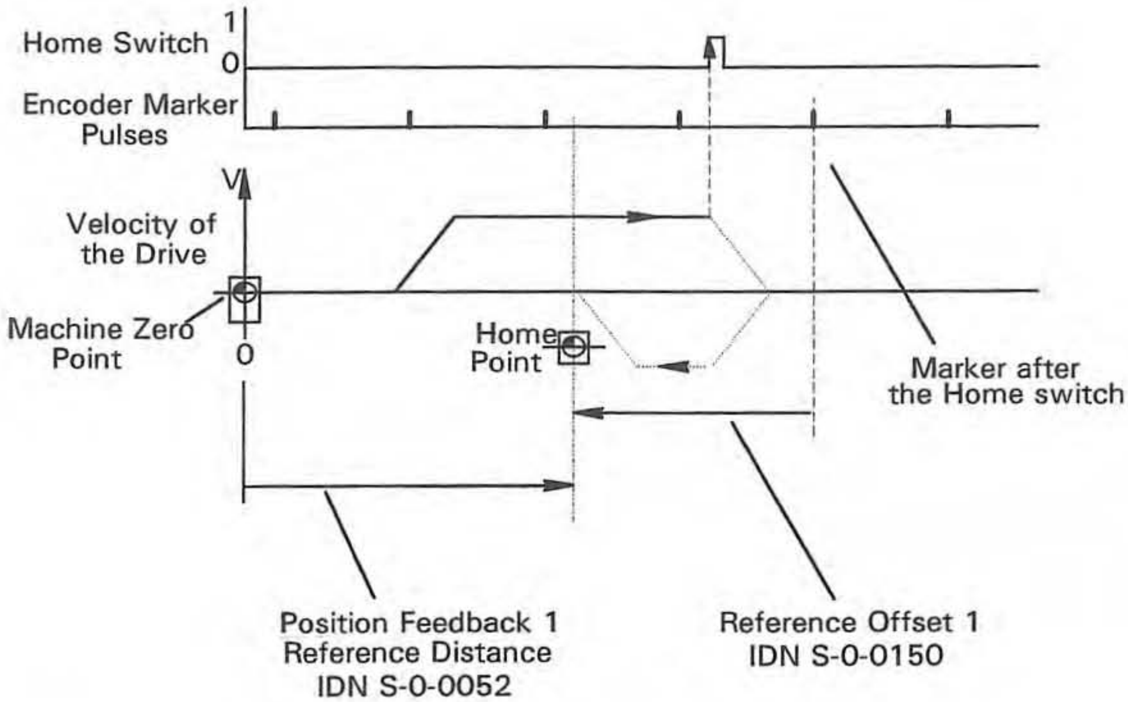


Figure 2.24 Homing Procedure with a Negative Reference Offset Value

2.4.4. DDS 2.1 Oscilloscope Function

In any servo drive system, it is a fundamental requirement that the drive provide signal monitoring points for diagnostic purposes. In a digital drive, one way to implement these signals is to use digital to analog, (D/A), converters. The DDS 2.1 has an additional capability. Since most of the signals to be displayed are already in a digital format, the drive can easily sample and store these digital values at a defined sample rate. These stored values can then be sent over the SERCOS Interface to the control unit that can in turn plot the signals on the user interface screen. This provides a means of capturing noise free signals from the drives.

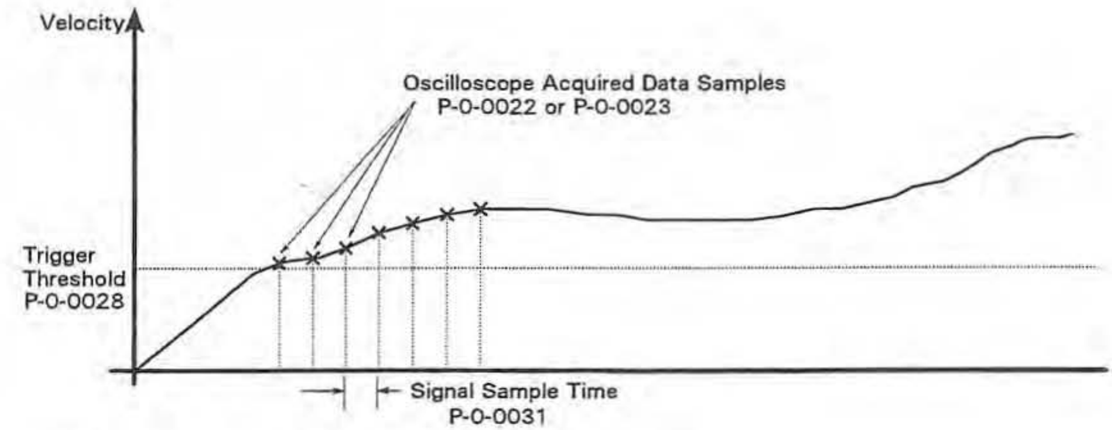


Figure 2.25 Example of the DDS 2.1 Oscilloscope Function

The DDS 2.1 allows torque, velocity or position data to be captured in the drive. The sample rate is programmable through IDN P-0-0031 and can be programmed up to the update rate of the drive, i.e., 250 μsec. Two channels of up to 512 samples /channel can be stored in each drive. Since the drives are synchronized over the SERCOS Interface, the data capture for multiple drives is also synchronized. Trigger points can also be configured based on any of the available signals, or from an external Real Time input. Once the data is obtained by the control unit, this data can be plotted, processed or manipulated mathematically for unlimited methods of analysis.

The parameters that apply to the oscilloscope function are as follows:

P-0-0021 Oscilloscope Channel 1 - Acquired Data Samples
P-0-0022 Oscilloscope Channel 2 - Acquired Data Samples
P-0-0023 Oscilloscope Signal Selection - Channel 1
P-0-0024 Oscilloscope Signal Selection - Channel 2
P-0-0025 Trigger Source
P-0-0026 Trigger Signal Selection
P-0-0027 Trigger Threshold for Position Data
P-0-0028 Trigger Threshold for Velocity Data
P-0-0029 Trigger Threshold for Torque Data
P-0-0030 Trigger Mode
P-0-0031 Signal Sample Time (Time Divisions)
P-0-0032 Oscilloscope Signal Memory Allocation
P-0-0033 Number of Samples After the Start of the Recording
P-0-0035 Trigger Offset
P-0-0036 Trigger Control Word
P-0-0037 Trigger Status Word

For more detailed descriptions of these parameters, see section 2.1.4, Product Specific Parameters.

2.4.5. Probing or Position Registration Function

A probe is typically used to define the position of a part or depth of a hole or cut. The probe is configured with some type of touch sensitive switch at its tip. It measures a surface by being slowly moved toward a surface. When the tip touches the surface, the switch closes, signaling the latching of the position data.

Position registration is similar to probing in that a switch closure, (i.e., optical switch, proximity switch, etc.), will signal the latching of the position data.

In most configurations, the probing or position registration is done in the control unit. Since the position feedback data acquisition is done directly in the DDS 2.1, it is faster and more convenient to latch the position in the drive. This is done with the use of the Real Time Bits.

The following example will illustrate the operation of the real time bits in a probing application:

Example:

The figure below shows a 2 axis system performing a probing function. When the probe touches the part, the drives will immediately latch the position data from the motor feedbacks. The control unit is simultaneously notified that the probe switched has closed via the real time bits of the drive status words.

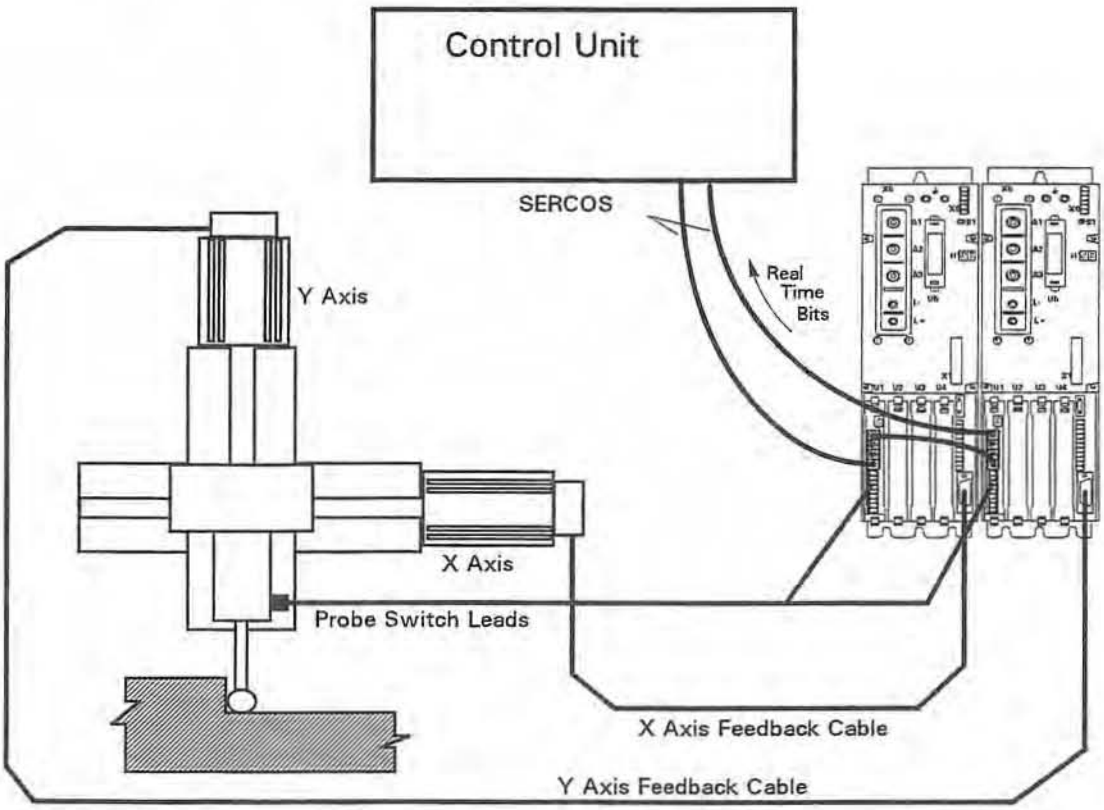


Figure 2.26 Axis Probing

Before setting up this example, a few assumptions are made. Real Time Bit 1will be used to indicate to the control unit when Probe 1 closes . Real Time Bit 2will be used to indicate to the control unit when Probe 1 position is latched. The probe position will be latched on the positive going edge of the probe switch signal, i.e., on the closing edge of the probe switch.

To set up this example, the following steps are executed:

1. Load S-0-0305, (Allocation of Real Time Status Bit 1), with IDN S-0-0401, (Probe 1).

   S-0-0305:

0 0 0 0 0 0 0 0	0 0 0 0 0 4 0 1

2. Load S-0-0307, (Allocation of Real Time Status Bit 2), with IDN S-0-0409, (Probe 1 Positive Edge Latched).

   S-0-0307:

0 0 0 0 0 0 0 0	0 0 0 0 0 4 0 9

3. Set IDN S-0-0169, Probe Control Parameter. In this case, bit 0 will be set to 1 to activate the probe 1 positive edge.

4. Set IDN S-0-0405, Probe 1 Enable, bit 0 to "1". This enables probe 1.

5. Start the probing cycle procedure command, IDN S-0-0170. (This is done by setting bits 0 and 1 to "1 1" and then back to "0 0".)

6. When the probe switch closes, the position will be latched and stored in IDN S-0-130, Probe 1 - Positive Edge Position Value. In the next AT after the probe switch closes, the real time status bit 1 will be set to "1." In the AT following the position latching, the real time status bit 2 will be set to "1," indicating to the control unit that the position was latched. (See steps 1 and 2 above.)

2.4.6. Absolute Positioning and Rotary (Modulo) Axes

The standard DSF high resolution feedbacks for the MDD motors are single-turn absolute. This means that when the system is powered down and back up, the angular position can be determined within one revolution of the motor shaft. If the motor rotates multiple revolutions, the drive can determine absolute position as long as the system is not powered down.

For a system that requires absolute position over multiple turns of the motor after cycling power, a DSF multiturn feedback is used. This option must be specified when ordering the MDD motor.

CHAPTER 3. ANALOG INTERFACE

3.1. Introduction

The analog interface option allows the DDS 2.1 drive to operate as an analog drive. This means that the drive may be commanded by an analog voltage signal and the drive will respond with a respective velocity or torque, depending on the selected mode. There are several advantages of a DDS 2.1 drive running with an analog interface over standard analog drives. The DDS 2.1 has 2 programmable analog outputs for signal monitoring and/or troubleshooting. In addition, all gains and parameters can be adjusted easily via the DDS 2.1's RS 232 port. A user interface for this port is implemented in the drive, so that when connected to a VT100 terminal or VT100 emulator, all parameters can be adjusted without additional software. Finally, if it is desired to run SERCOS in the future, the DAE 1.1 Analog Interface Card can be replaced with a DSS 1.1 SERCOS Interface Card and the DSM Card exchanged for an inexpensive upgrade to a SERCOS compatible drive.

3.2. DAE 1.1 - Analog Interface Module

The DAE 1.1 is plugged into the first slot of the DDS 2.1. This card contains two connectors on the front face. The top connector, X15, is a Pheonix connector and contains the analog inputs. The bottom connector is a 15 Pin D-Shell connector and is configured as an incremental encoder output.

3.3. Analog Inputs

Velocity Command Inputs

There is a differential input provided for the analog velocity command. The difference of voltage between the two terminals E1 and E2 controls the velocity of the motor shaft.

Drive Enable Input (RF)

The DDS 2.1 does an internal check when control voltages are first applied. If there are no problems and it is determined that the drive is ready for the bus voltage, (i.e., ready for main power), the diagnostic "bb" is shown on the two digit, 7 segment display, H1. Once main power is brought up, the drive will display the diagnostic "Ab". This means that all power has been brought up successfully and the drive is ready to be enabled. By applying a voltage between +12 and +32 v in the terminal labeled "RF", the drive will become enabled and will acknowledge this state by displaying "AF" on H1. Once the drive is enabled, it will respond to the commanded inputs, E1 and E2.

Note: RF can only be applied after main power has been applied.

Temperature Warning Output (TVW)

This output will go to a high level, (a high level is supplied by the +UL input described below), when there is an overtemperature warning condition existing, either in the motor or in the DDS. This output can source up to 100mA and is used for input into a PLC for monitoring purposes.

Drive Halt (AH)

This input is used to internally command a zero velocity. This is done when it is required to stop the motor shaft and maintain zero velocity without any drift. When this function is active, any signals on the E1, E2 inputs are ignored.

Note: This function is active low and therefore requires a high voltage level, (between +12 and +32 v), on this input in order to command the drive via the E1 and E2 inputs.

Current Reduction Inputs (Ired1, Ired2)

Three current or torque reduction levels can be selected with these inputs. These reduced torque values are preset via the RS 232 user interface terminal. These torque values represent a maximum holding torque that the motor will provide when selected. This is useful for driving into a positive stop, or for servo clamping applications. The torque reductions are selected by applying high voltage levels (between +12 and +32 v) to the Ired1 and Ired 2 inputs in a binary fashion as shown in the table below.

Ired1	Ired2	Selection	Torque Value in Percent of Continuous Holding Torque
0	0	Maximum Torque	No Reduction = 100% of Parameter Settings
0	1	Torque Reduction 1	80*
1	0	Torque Reduction 2	50*
1	1	Torque Reduction 3	20*

**Inserted values are examples only. Values may be preset by user.*

External 24V Input (+UL)

An external 24V must be supplied on this input and referenced to 0VL. This is required for proper operation of the DDS 2.1 in analog mode. The current draw on this input is 100mA. If this input voltage is missing, an error "33", External Power Supply Error will be displayed on H1.

3.4. Incremental Encoder Emulator Output, (X14)

The bottom 15-pin D-Shell connector on the DAE 1.1 card supplies an incremental encoder signal that is derived from the high resolution (DSF) feedback on the motor.
The signals from this encoder connection are shown below.

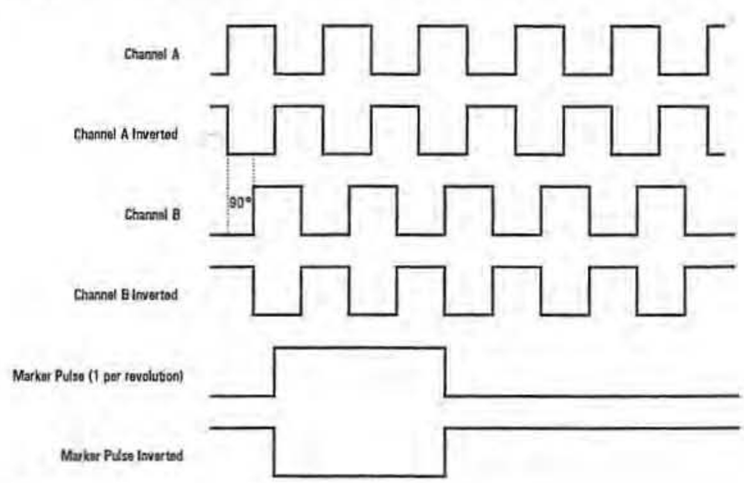


Figure 3.1 Incremental Encoder Signals

The actual number of cycles per motor revolution on the A and B channels can be selected via the RS232 user interface. The maximum number of cycles per revolution is 262,144. This count is frequency limited to a maximum of 1845 RPM. (See also section 3.9.1. Incremental Encoder Line Count).

3.5. RS232 Interface

The DDS 2.1 contains an RS232 interface connection. This interface gives you information regarding the status of the drive, the ability to run a function test from a terminal keyboard and allows you to read all parameters of the system and to change them if necessary. The DDS 2.1 provides screens and menus that are accessible via a VT 100 terminal, or a PC computer with a VT 100 emulator, (e.g. Procomm, Windows 3.1, etc.).

The communication settings are as follows:

Baud Rate:	9600
Parity:	None
Data Bits:	8
Stop Bits:	1

The cable configuration for a PC computer is shown below.

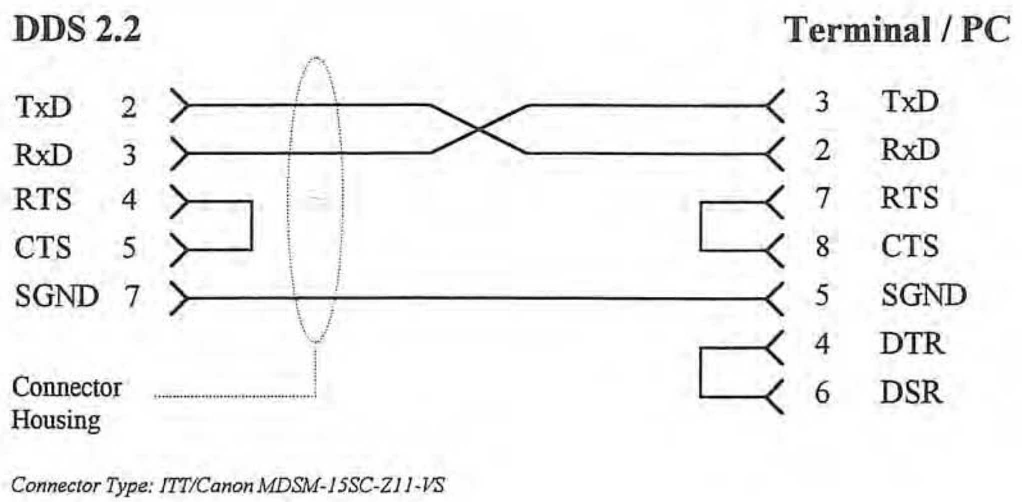


Figure 3.2 RS 232 C Interface Wiring Diagram

3.6. RS232 User Interface

The RS232 User Interface includes all menus for viewing system parameters and for changing some of these parameters. An overview of the menus is shown in the following figure:

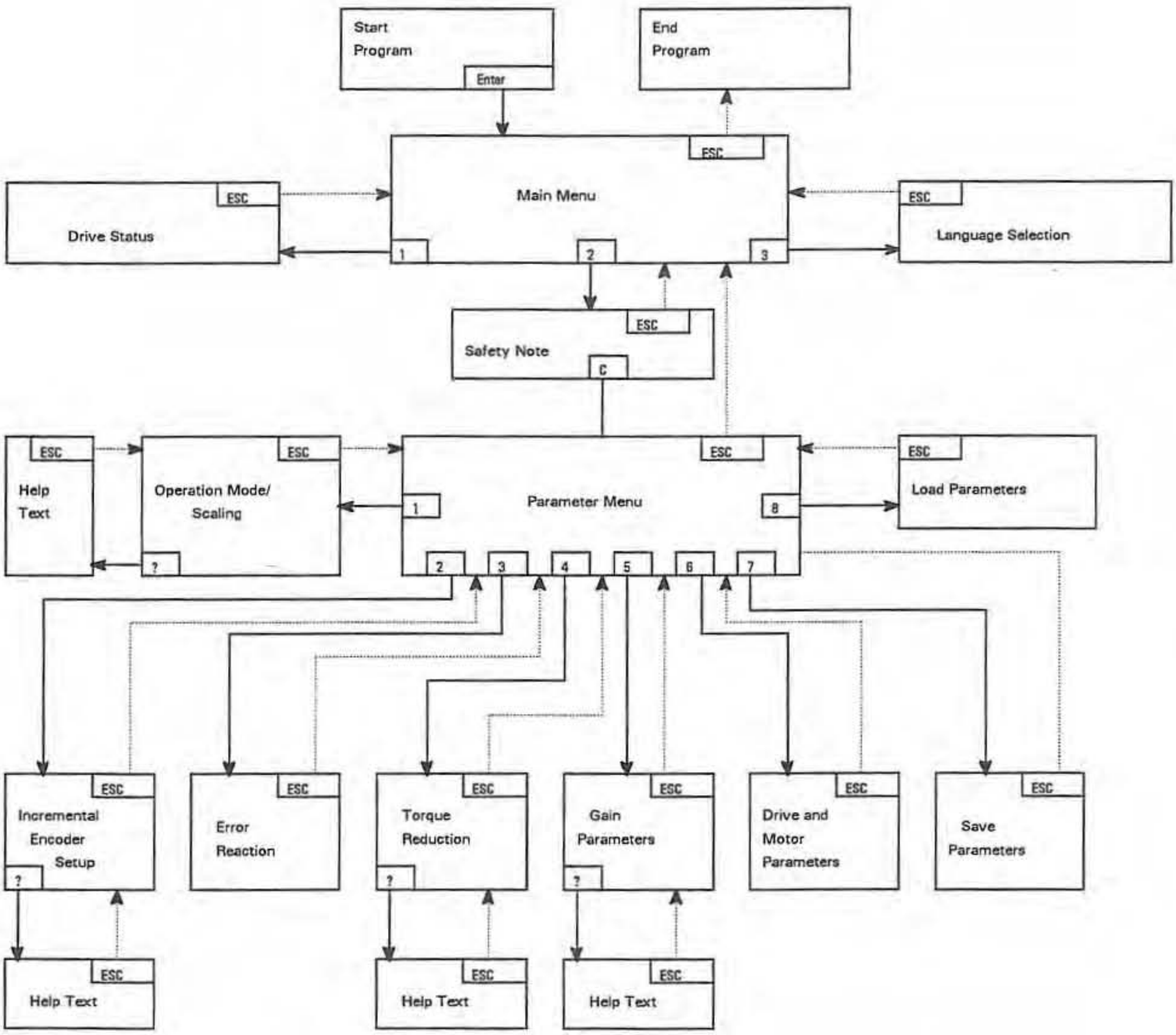


Figure 3.3 RS 232 / VT 100 User Interface Summary

Once the terminal is connected, the control voltage to the DDS 2.1 can be brought up and the terminal turned on. The user may begin communications by pressing the ENTER key. This will bring up the main menu:

```
================================================================================
  INDRAMAT                                    Control System and Servo Drive

                                  MAIN MENU
================================================================================
--------------------------------------------------------------------------------
Drive Status :    19   Motor Overtemperature Shutdown
--------------------------------------------------------------------------------
This parameterization and diagnostic program is designed to adapt the
DDS 2.1 Servo Drive with an analog interface module to both the control unit
and the mechanics of the machine.
In addition, diagnostic messages are provided.


   1   ->  Drive Status
   2   ->  Parameters
   3   ->  Language Selection / Sprachauswahl
   ESC ->  Exit Program



Select a number from the menu above or ESC:
```

3.6.1. Language Selection

In order to change the language displayed on the screen, select "3" from the main menu.

For English text select "e".
For German text select "d".

3.6.2. Drive Status

In order to view the drive status, select "1" from the main menu. The following screen will be displayed with the appropriate data inserted after the colons:

```
================================================================================
                                DRIVE STATUS
================================================================================
--------------------------------------------------------------------------------
Drive Status :    100 Ready for main power (Bb closed)
--------------------------------------------------------------------------------

  Motor Type                   : MDD090C-N-030-N2L-110PB1
  Amplifier Type               : DDS2.1-W050-D
  Software Version             : DSM 2.1-E11-01.04   (03.03.93)

  Active Operation Mode        : Velocity Regulation
  Velocity Command Value  (RPM): 0.0000
  Velocity Feedback Value (RPM): 0.0000
  Current Command Value   (A)  : 0.00
  Motor Torque            (NM) : 0.00
  Relative Motor Torque   (%)  : 0.00

  Rotor Position Revolutions   : 0.3457
                 Angular (degr): 124.4531  0229

                              TVW     RF     Ah     Ired1    Ired2   Marker Pulse
  I/O - Status  DAE / DAA:     1       0      1       0        0         0
  ESC -> Return to main menu
```

3.7. Parameters

In order to view and/or change system parameters, select "2" from the main menu. The following menu will be displayed:

```
==============================================================================
   INDRAMAT                                     Control System and Servo Drive

                              PARAMETER MENU
==============================================================================

Application Parameters:
----------------------
   1  ->  Operation Mode, Scaling
   2  ->  Encoder Emulation Setup
   3  ->  Error Reaction
   4  ->  Torque (Current) Limits

Drive Parameters:
----------------
   5  ->  Gain Parameters
   6  ->  Motor and Drive Data

Parameter Management
--------------------
   7  ->  Save Parameters to Disk
   8  ->  Load Parameters from Disk

Select a number from the menu above or ESC to return to main menu:
```

This menu allows you to select from various parameter groups. These parameter groups contain all the parameters that are necessary for the respective applications.

3.8. Operation Modes, Scaling

```
================================================================================
                        OPERATION MODES, SCALING
================================================================================
--------------------------------------------------------------------------------
Drive Status :   100 Ready for main power (Bb closed)
--------------------------------------------------------------------------------


Analog Output :
Channel 1 ->  Current Command Value
Channel 2 ->  Velocity Feedback Value

Operation Mode(1= Torque / 2= Velocity Regulation): 2__________
Bipolar Velocity Limit Value                  (RPM): 2600.0000___
Overload Factor                               ( % ): 100________
Maximum Command Value for Maximum Velocity      (V): 10.0_______
Velocity at Maximum Command Value             (RPM): 2500_______
Command Value Smoothing Filter Time Constant(msec): 2.00_______
Position Data Scaling at the Analog Outp.(dgr/10V): 360.0______
Velocity Data Scaling at the Analog Outp.(RPM/10V): 2500_______

? -> Help ; ESC -> Abort Input  /  Return to Parameter Menu
```

3.8.1. Operation Mode

The parameter "Operation Mode" allows the user to select between two modes of operation, (or interface configurations). The control loop selected determines the outermost loop that is to operate in the drive:

1. Torque Loop Regulation Mode

2. Velocity Loop Regulation Mode

3.8.2. Bipolar Velocity Limits

The parameter "Bipolar Velocity Limits" sets the value for the velocity limits in both directions. This is the maximum speed that the motor will run .

3.8.3. Overload Factor

The overload factor is determined based on the desired intermittent torque as follows:

$$\text{Overload Factor} = \frac{\text{Intermittent Torque}}{\text{Continuous Torque}} * 100$$

The permissible intermittent torque is dependent on the duty cycle. (See DDS/MDD Selection List).

Depending on the application, the overload factor can be adjusted manually. In this case, the duty cycle must be observed as follows:

$$DutyCycle = \frac{T_{cont}^2}{T_{int.}^2} \times 100\%$$

Where:

T_{cont} = *Continuous Torque*

$T_{int.}$ = *Intermittent Torque*

3.8.4. Command Value Scaling

The Command Input Scaling determines the velocity in which the motor will run at a given command voltage. This value is represented by the following ratio:

$$Command\ Input\ Speed\ Scaling = \frac{Vin_{max}}{RPM_{max}}$$

Where:

RPM_{max} = Velocity in RPM
Vin_{max} = Desired input voltage at RPM_{max}, (maximum value = 10V)

3.8.5. Command Value Smoothing Filter Time Constant

The input velocity or torque command value can be smoothed via this parameter. This can be useful in cases where a noisy command line is present. The more typical application of this parameter is seen in cases where a stairstep is present due to a lower resolution D/A converter on a control when an acceleration is being commanded.

The filtering effect is increased with larger values. A value of 250μsec turns the filtering off completely

3.8.6. Analog Outputs

There are two analog outputs, AK1 and AK2, on connector X3 of the DDS 2.1 which can be used for diagnostics. The signals to be analyzed on these outputs are selectable in this Operation

Modes menu. Channels 1 and 2 correspond to AK1 and AK2 respectively. The signals may be selected from the following:

- Velocity Command Value
- Velocity Feedback Value
- Position Command Value
- Current Command Value
- Motor Encoder Sinusoidal Signal
- Motor Encoder Cosinusoidal Signal

The velocity values at these outputs can also be scaled in this menu in RPM per 10V. This scaling is linear, so that if 3000 RPM/10V is entered, 5V will appear on these outputs if 1500 RPM is commanded.

NOTE: This scaling is for the outputs AK1 and AK2 only and does not apply to the voltage at the command inputs of the analog card, E1/E2. The scaling for these inputs are discussed above in this section.

The position values at these outputs are represented by a voltage proportional to a given distance. These values can also be scaled in this menu in units of degrees per 10V. As an example, if 360° were entered, one revolution of the motor shaft would provide one linear voltage ramp from 0 to 10V as shown in the figure below.

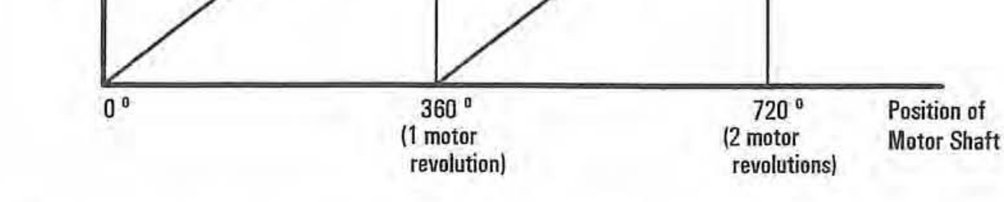


Figure 3.4 Analog Output Representation of Position Signal

3.8.7. Getting around in the Operation Modes, Scaling Screen

Parameter Changes:
Move the cursor to the parameter to be changed.
Enter the new parameter value and hit enter.

Analog Output Changes:
Move the cursor to channel 1 or channel 2.
Select the desired output signals with the left and right arrow keys.

Input Limits:

Operation Mode	: 1 or 2
Bipolar Velocity Limit Value	: 0 ... 50000
Overload Factor	: 0 ... 400
Maximum Command Value for Desired Velocity	: 0 ... 10
Velocity at Maximum Command Value	: 0 ... 65000
Command Value Smoothing Filter Time Constant	: 0.25 ... 1000
Position Data Scaling at the Analog Output	: 0.1 ... 1474560
Velocity Data Scaling at the Analog Output	: 1 ... 65000

The command scaling is determined by the value input at Max. Command Value and the corresponding velocity.

Example:

A speed of 2000 Rpm at 8V corresponds to the inputs:

'Maximum Command Value for Desired Velocity' = 8
and
'Velocity at Maximum Command Value' = 2000.

The input may not be greater than 65000RPM at 10V or 3250RPM at 0.5V.

3.9. Incremental Encoder Emulation Setup

```
================================================================================
                          INCREMENTAL ENCODER SETUP
================================================================================
--------------------------------------------------------------------------------
Drive Status :    100 Ready for main power (Bb closed)
--------------------------------------------------------------------------------

NOTE : These parameters can only be changed when the drive is not enabled,
       (RF is not applied).

       The line count that has been entered must agree with the control unit
       The maximum line count may also be limited by the maximum motor speed.
       See DDS 2.1 Users Manual.

Incremental Encoder Line Count  (1...262144)         : 2500________
Marker Pulse Offset             (0...359.9 degrees)  : 0.0_________

Rotor Position :            Revolutions              : 0.3496
                            Angular        (degrees) : 125.8594


? -> Help ; ESC -> Abort Input  /  Return to Parameter Menu
```

3.9.1. Incremental Encoder Line Count

The incremental encoder output of the DAE 1.1 or DAA 1.1 card represents motor position in the same way that a typical incremental encoder would, (see 3.1. Introduction). The encoder count defines the number of encoder cycles per revolution of the motor shaft. This encoder count can be programmed in this menu up to 16,383 cycles per revolution. The maximum count which can be programmed is limited to a frequency of 504 kHz, which is affected by motor speed. This limitation is shown as follows:

$$n_{max} = \frac{60 \times 504,000}{\text{Line Count}}$$

where n_{max} is the maximum motor speed in RPM for the given encoder line count. This results in a maximum speed of 1845 RPM for an encoder line count of 262,144. If a higher speed is required, the line count must be reduced accordingly to accommodate this speed.

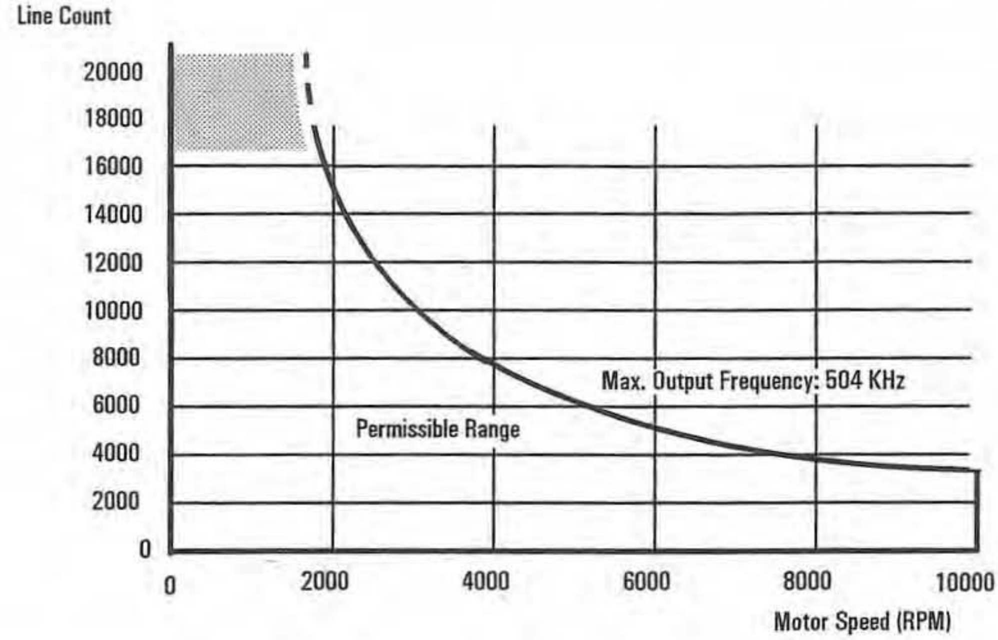


Figure 3.5 Motor Speed vs. Encoder Line Count

3.9.2. Marker Pulse Offset

In the case of a homing procedure as well as other applications which look at the marker pulse, it is often required to adjust the position of the marker pulse. This is typically done by aligning the motor shaft with the mechanics based on the position of the marker pulse, or physically adjusting the feedback to the motor shaft. In the case of the DDS 2.1, it is possible to adjust this marker pulse offset in this menu. This is done by adding this angular offset in degrees to the present position of the marker pulse. The values for this offset may be between 0 and 359.9 degrees.

3.10. Error Reaction

```
================================================================================
                              ERROR REACTION
================================================================================
--------------------------------------------------------------------------------
Drive Status :  100 Ready for main power (Bb closed)
--------------------------------------------------------------------------------

0 -> The drive automatically switches to velocity loop regulation and provides
     a velocity command value of 0. After 500 msec, the motor torque is disabled
     and an error signal is sent to the power supply on the X1 (X1.2) connector.

1 -> The drive reacts the same as in error reaction 0, with the exception that
     the drive does not signal the power supply that an error has occurred.

2 -> The drive immediately switches its torque to 0. No signal is provided
     to the power supply.

Current selection     0__________-> change to:


Press ENTER to confirm change or 'ESC' to return to main menu
```

The Error Reaction selected determines how the drive will react when a shutdown error occurs. Three possibilities exist and are explained in this menu.

3.11. Torque (Current) Reduction

```
================================================================================
                    TORQUE/CURRENT LIMITS
================================================================================
--------------------------------------------------------------------------------
Drive Status :   100 Ready for main power (Bb closed)
--------------------------------------------------------------------------------

The motor torque is adjusted in this menu. There are 2 Ired control inputs
which will allow 4 different current limit values. These values can be
in a range from 0% to 400%. 100% = Continuous Motor Current (Torque).


  Ired2   Ired1         Adjustment

    0       0      Full Torque
    0       1      Current Limit  1    at    ...% : 5__________
    1       0      Current Limit  2    at    ...% : 10_________
    1       1      Current Limit  3    at    ...% : 15_________


? -> Help ; ESC -> Abort Input  /  Return to Parameter Menu
```

Three torque or current reduction values may be set in the drive in this menu. These values are then selected in a binary fashion by applying a voltage between 12 and 32 volts for a binary "1" and 0 to 3 volts for a binary "0" on Ired 1 and 2 inputs. A "0-0" on these inputs indicates no torque reduction.

3.12. Gain Parameters

```
================================================================================
                               GAIN PARAMETERS
================================================================================
--------------------------------------------------------------------------------
Drive Status :    100 Ready for main power (Bb closed)
--------------------------------------------------------------------------------

WARNING: See DDS 2.1 Users Manual Before Adjusting Gains !

Analog Output :
Channel 1 ->  Current Command Value
Channel 2 ->  Velocity Feedback Value

Current Loop Proportional Gain-1              (V/A) : 4.80________
Velocity Loop Proportional Gain Kp        (mAs/rad): 2000________
Velocity Loop Integral Reaction Time Tn        (ms): 4.0_________
Velocity Loop Derivative/Integral Gain    (mAs/rad): 0___________
Velocity Loop Derivative/Proport. Gain (uAs2/rad): 0___________
Smoothing Time Constant                      (usec): 1300________
Reset to Standard Parameters        -> ENTER      : ............


? -> Help ; ESC -> Abort Input  /  Return to Parameter Menu
```

This menu contains the gain parameters for the drive. A simplified block diagram of these gains is shown below.

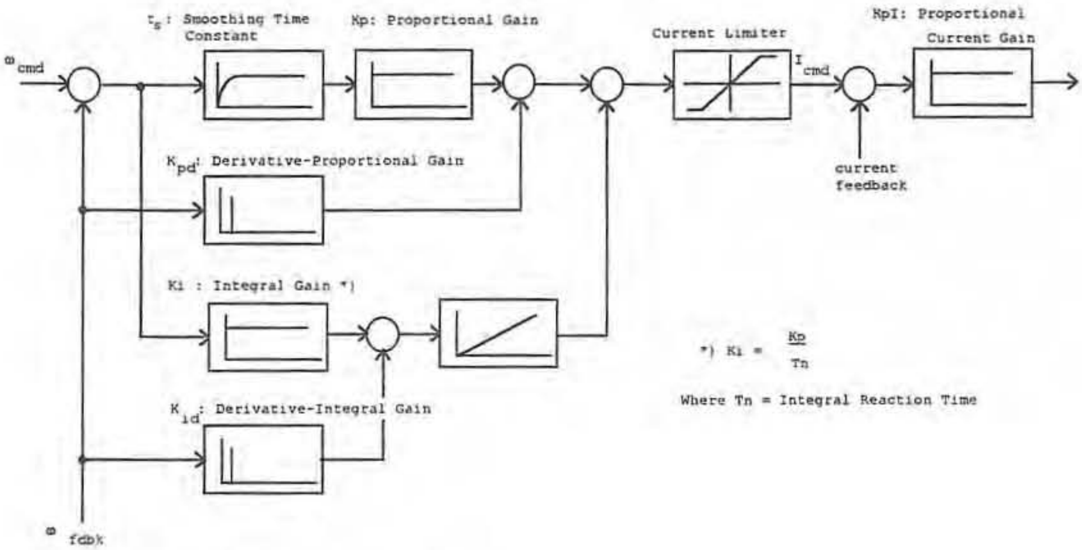


Figure 3.6 Block Diagram of Gain Parameters

These gains are adjusted to standard values automatically when the drive is first powered up. This is done by gathering the data from the motor and setting gains for an ideal matching of inertia, with a

1:1 ratio between the load and the motor. If the load inertia is much larger than the motor inertia, gain adjustments may be necessary.

3.13. Motor and Drive Parameters

```
---------------------------------------------------------------------------------
Drive Status :   100 Ready for main power (Bb closed)
---------------------------------------------------------------------------------

Amplifier Parameters
--------------------
Amplifier Type                      :  DDS2.1-W050-D @ABCDEFGHIJKLMNOPQRSTUVWXY
Amplifier Peak Current           (A):  50.0
Amplifier Continuous Current     (A):  40.0
Effective Peak Current           (A):  50.0
Effective Continuous Current     (A):  17.4

Motor Parameters
----------------
Motor Type                          :  256 90C-N-030-N2L-110PB1U 3   U 3   U 3
Nominal Torque              (Nm)    :  9.7
Maximum Velocity of Motor   (RPM)   :  4100.0000
Mass Moment of Inertia      (kg m2) :  0.00530
Motor Torque Constant       (Nm/A)  :  0.5600
Peak Motor Current          (A)     :  62.5
Nominal Motor Current       (A)     :  17.4

Press ESC to return to main menu
```

3.13.1. Amplifier Type

This describes the DDS 2.1. The type code can be found in Appendix E.

3.13.2. Amplifier Peak Current

This is the maximum current which the DDS 2.1 can provide for a time period of approximately 400msec. Once this time period has elapsed, the drive current folds back to the Amplifier Continuous Current.

3.13.3. Amplifier Continuous Current

This is the current which the drive folds back to once the amplifier peak current has been maintained for 400msec.

3.13.4. Effective Peak Current

The peak current which a motor/drive system has available may be limited by the motor or the drive. The effective peak current gives the allowable peak current for the entire system. The effective peak current is also affected by the overload factor. The higher the overload factor, the lower the effective peak current.

3.13.5. Effective Continuous Current

The continuous current which a motor/drive system has available can be limited by the motor or the drive. The effective continuous current gives the allowable continuous current for the entire system. The effective continuous current is also affected by the overload factor. The higher the overload factor, the higher the effective continuous current.

3.13.6. Motor Type

This describes the DDS 2.1. The type code can be found in Appendix E.

3.13.7. Nominal Torque

This is the continuous torque of the motor at stand still. This torque may be applied for an undefined period of time without exceeding the motor thermal limits.

3.13.8. Maximum Motor Velocity

The maximum velocity that the motor can run at.

3.13.9. Mass Moment of Inertia

This is the mass moment of inertia of the motor shaft in units of kgm^2.

3.13.10. Motor Torque Constant

This constant relates motor torque to motor current by the following:

$$T\ (Nm) = K_T * I_{mot}\ (Amps)$$

Where: T = motor torque
K_T = motor torque constant in Nm/Amp
I_{mot} = motor current

3.13.11. Motor Peak Current

The maximum current that the motor is rated for.

3.13.12. Motor Continuous Current

This is the continuous current of the motor. This current may be applied for an undefined period of time without exceeding the motor thermal limits.

3.13.13. Saving Parameters to Disk

To Save Parameters:

Press "7" in the Parameter Menu. The following menu should be displayed as the questions for machine data at the top of the screen are answered:

```
================================================================================
                                SAVE PARAMETER
================================================================================

Machine-Manufacturer : XYZ Machine Co.
Machine-No.          : OP 123
Machine-Type         : Milling
Axis                 : X
Date, inspected by   : 6/3/93



to save parameters:
   - if you are using 'DDS2PC' as emulator hit ALT-S otherwise follow instruction

   - put terminal emulator in receive-mode (Download)
   - enter filename (to save parameters to)
   - use text or ASCII download format
   - then press switch S1 at DDS2 to start downloading
   - after the last character received ('$') then exit receive-mode
   - hit one more key to return to main menu
NOTE: to exit this menu even without saving you must press S1 and hit any key
```

If you are using Indramat's "DDS2 PC Terminal Emulation Software", you can proceed by pressing "ALT-S".

If you are using another terminal emulator software, execute the following:

1) Put the terminal emulator in receive mode (Download).

2) Enter a filename to save parameters to.

3) Use a text or ASCII file format.

4) Press the S1 switch on the DDS 2.1 to start downloading.

5) After the last character is received ($$$), then exit the receive mode.

6) Press any key to return to the Main Menu.

3.13.14. Loading Parameters from Disk

Press "8" in the Parameter Menu. The following menu should be displayed:

```
==================================================================================
                              LOAD PARAMETER
==================================================================================

to load parameters:

if you are using DDS2PC as emulator, only hit ALT-L otherwise follow instruction

  - put terminal emulator in send-mode (Upload)
  - enter filename (to load parameters from)
  - use text or ASCII format
  - start uploading (from terminal emulator)


Continue with 'Load Parameter' ?  yes -> 'y'
```

If you are using Indramat's "DDS2 PC Terminal Emulation Software", you can proceed by pressing "ALT-L".

If you are using another terminal emulator software, execute the following:

1) Press "y" to continue. (Warning: Do not start sending data until after "y" is pressed)

2) Put the terminal emulator in send mode.

3) Enter a filename to load parameters from.

4) Use a text or ASCII file format.

5) Start the uploading or sending of data from the PC.

6) The screen will then prompt you to press any key to return to the Main Menu when the upload is complete.

CHAPTER 4. INSTALLATION

4.1. General Considerations

4.1.1. Panel Layout

DDS amplifiers are designed for panel mounting in a sealed (NEMA 12) enclosure along with a TVD/NAM, TVM or KDV power supply and possibly a 3-phase transformer. Mechanical dimensions have been chosen so that one power supply module and two to three servo amplifier modules fit side by side in a 19 inch cabinet. Any number of modules can be mounted side by side.

Figure 4.1 Power Supply and 2 Amplifiers illustrates a typical installation. The minimum spacing distances cited in this drawing must be observed to assure an adequate flow of cooling air. Other components that generate heat, such as power transformers, must be mounted where they do not affect the servo system. If possible, mount such components in a separate enclosure. If this is not possible, mount these components to the side or above the servo modules, never directly below them.

The power supply module must be at one end of the assembly with all servo amplifier modules to one side.

4.1.2. Signal Wiring

Care must be taken to assure that electrical noise is not induced into the signal wiring.

Do this by:
1) routing signal wiring separately from power wiring and,
2) following good shielding and grounding practice.

Signal wiring should never be run in the same conduit as power wiring. If necessary, power and signal wiring may share the same square wire trough, provided a metal dividing wall separates the two. Power wiring and signal wiring should also be separated as much as possible within the enclosure. Do this by running these wires as far apart as possible from each other, avoiding parallel runs, and making sure that any required intersections are at right angles.

Signal wiring should be run with twisted, shielded wire; #20AWG or larger. Connect the shield to ground at only one end. Normally the shield would be connected to the ground terminal of the servo amplifier. (See the wiring diagram for your specific servo amplifier

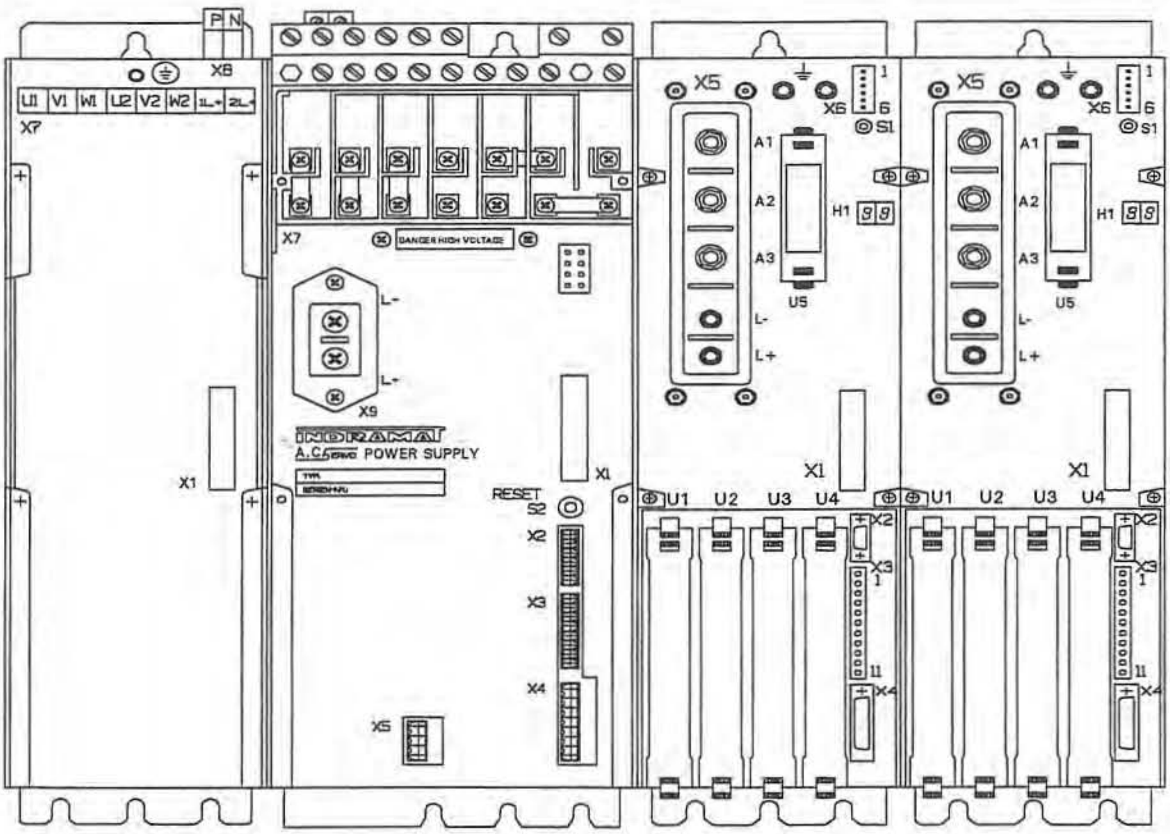


Figure 4.1 Power Supply and 2 Amplifiers

model to locate this terminal.) In general, avoid making ground connections at more than one point as this creates "ground loops" which are a potential source for the introduction of electrical noise.

4.1.2.1. DDS 2.1 Configurations

Since the DDS 2.1 has plug-in slots to allow for various options, it must be ordered by configuration. A configuration number determines which plug-in boards will be configured in the drive, as well as the software version. Before installing the equipment, check to make sure the equipment is configured correctly. The Plexiglas cover on the front of the drive should accurately describe the boards which are installed.

System Configuration

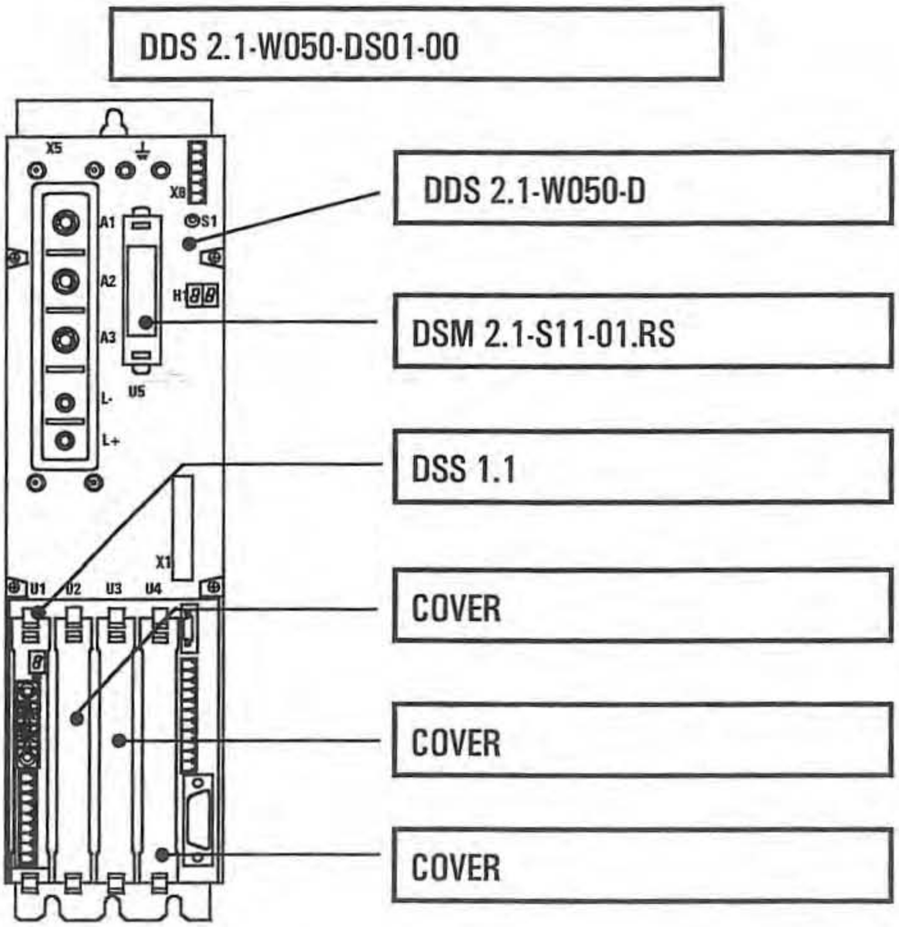


Figure 4.2 Configuration Sticker (on Plexiglas cover of DDS 2.1)

4.1.2.2. Signal Descriptions

Signal Descriptions for the DDS 2.1 and the main interface plug in modules are described in this section.

AK1 and AK2 Programmable Outputs

The AK1 and AK2 outputs on pins 1 and 3 of connector X3 on the DDS 2.1 are programmable outputs for diagnostic purposes. These signals are referenced to 0Vm which is found on terminals 2 and 4 of X3. These outputs can be selected either via the RS232 user interface (when using an analog interface option), or via a SERCOS control unit (e.g. MT-CNC, CLC, etc.). When using the SERCOS Interface to communicate to the DDS, IDN's P-0-0038 and P-0-0039 are used to select output signals for AK1 and AK2 respectively. Position and Velocity data at these outputs can also be scaled independently with IDN's P-0-0040 to P-0-0043.

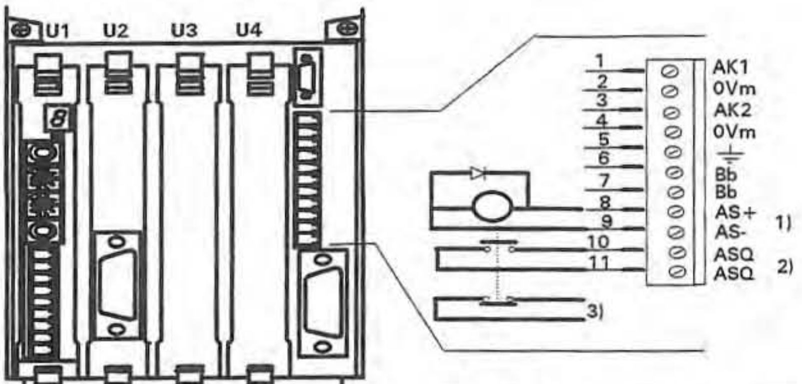
Bb - Drive Ready Contacts

When powering up a DDS servo system, the drive does an internal diagnostic check to insure that no errors exist that would prevent the turning on of main 3ϕ power. If all is clear for main power to be applied to the system, diagnostic "bb" appears in the H1 display and the dry contact between the Bb terminals, (pins 6 and 7 of connector X3), is closed. When using a TVD power supply, the Bb status is also monitored internally, preventing main power to be applied. When using a TVD, it is recommended to use the Bb contacts as acknowledgments that the drives are ready for main power. The power rating for this contact is +24 V at 1mA.

AS+, AS-, ASQ Safety Interlock Contacts

The AS Safety Interlock function is used in cases where it is required to completely shut down the power section of selected drives and totally remove power to the motor. When this power down occurs, other drives in the same system are allowed to maintain their power and operational capability. This provides a safe working environment around the axes which have their AS function active without having to power down the complete system.

To activate the AS function, drive must be disabled, (i.e. remove RF enable signal). Apply +24V to the terminal AS+, (pin 8 of connector X3), with the 0V reference tied to AS-, (pin 9 of connector X3). Once the AS function is active and the axis is considered safe, the AS acknowledge contact between the ASQ pins will be closed. This acknowledge contact must be monitored by the control logic to insure that the drive cannot be restarted while the AS function is active. This can also be used to signify that the AS function has been disabled and the axis is no longer considered to be in a safe mode.

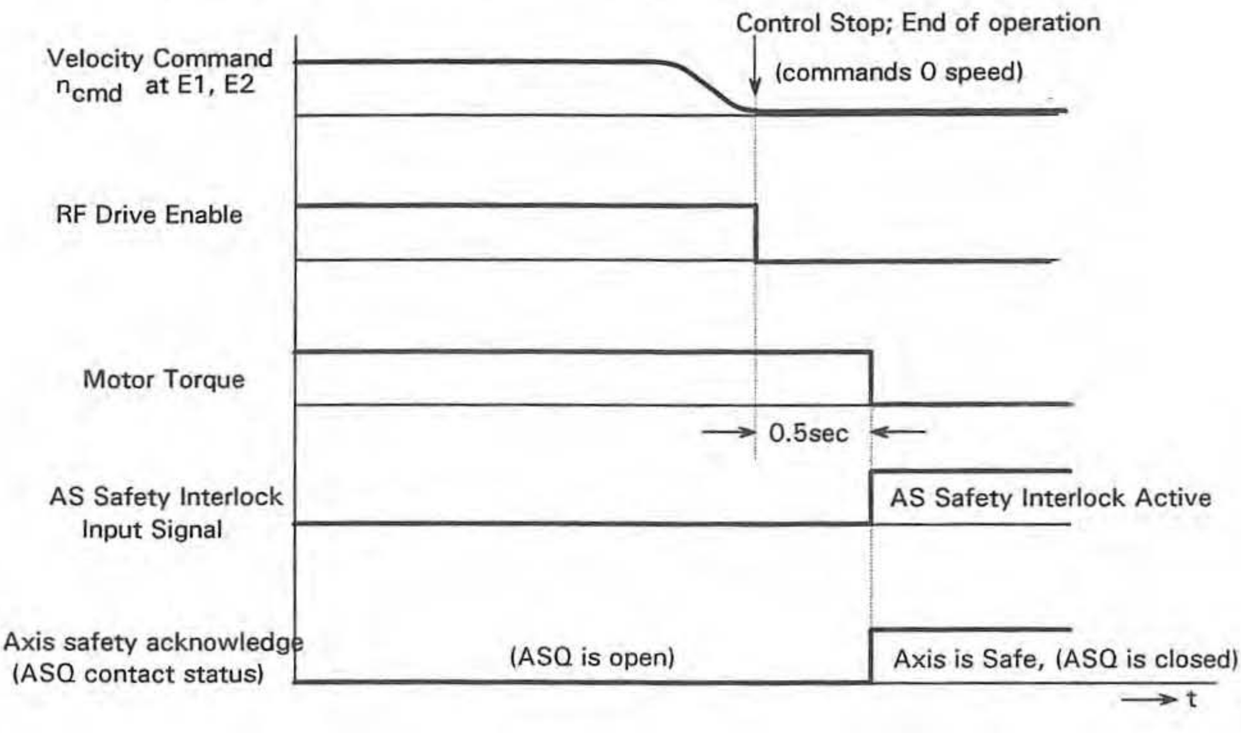


1) AS+, AS- : Control input for AS function 20 - 30 VDC, 1.5W

2) ASQ Contacts : AS monitor outputs, 24VDC, 1A

3) Internal contact which disables power section in the drive.

The following timing diagram describes the switching of the AS Safety Interlock:

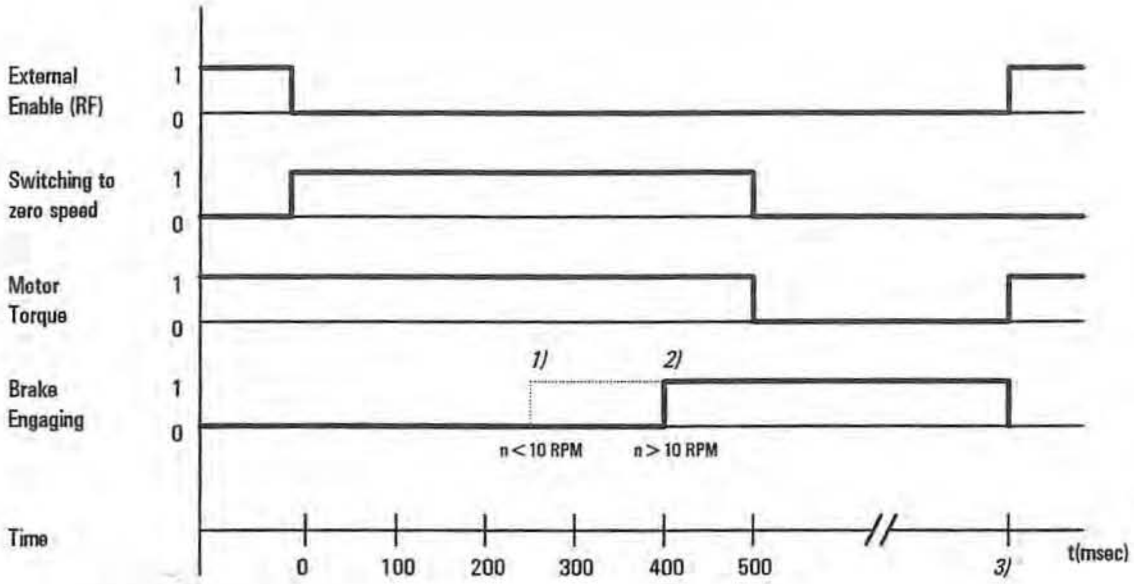


Motor Thermal Switch Inputs

The DDS 2.1 monitors the motor thermal switch via inputs TM+ and TM-, (pins 1 and 2 on connector X6). When the motor exceeds its maximum operating temperature and the thermal switch opens, the drive will issue a motor over temperature warning and continue to operate for 30 sec. If the switch is still open after the 30 sec time period has elapsed, the drive will go into an over temperature shutdown. These inputs are not polarity sensitive.

Brake Control Output

The brake control output BR, (pin 4 on connector X6 and referenced to $0V_B$, pin 5 on X6), essentially controls the release and application of the motor brake. When the motor has torque (which is controlled by the drive), the drive automatically releases the brake by providing +24V to the motor brake. When torque is to be turned off, the brake is applied by removing the +24V. ***NOTE: In order to operate the brake, a +24 V (± 10%) external power supply must be connected to the U_B input referenced to $0V_B$ REF., (pins 3 and 6 respectively on connector X6).*** (See specific MDD motor data sheets to determine total brake current requirements).



1) Braking condition when motor velocity is under 10 RPM.

2) Braking occurs after 400 msec when motor velocity is over 10 RPM.

3) The brake is released at the same time RF enable is applied.

Note: 100 msec after the brake is engaged, the motor torque is removed.

DSS 1.1 SERCOS Interface Card

Home Switch - E1

The DDS 2.1 drive has the ability to perform a drive controlled homing function running with the SERCOS Interface. The home switch is connected to input E1 on the DSS 1.1 card, (pin 1 on connector X12). This input is active high. (For more details on the homing function, see Chapter 5).

Overtravel Limit Switches - E2, E3

There are two inputs which allow the SERCOS configured DDS 2.1 to monitor overtravel limit switches. The positive and negative overtravel limit switch inputs are defined as the E2 and E3 inputs respectively, (pins 2 and 3 on connector X12). These inputs will result in an error "44" on the H1 display and the drive will internally command a zero velocity, decelerating the motor, regardless of the error reaction mode. These inputs are active high.

Probe 1 and 2 - E4, E5

There are two probe inputs available which allow the drive to perform real time probing at the drive. Since the drive is capable of closing a position loop, it has direct access to position feedback data at all times. When a probing function is activated, the drive latches the position being processed as soon as the input is activated, (i.e. the switch closes). The drive then notifies the master in the next SERCOS cycle that the probe input was activated and the position has been latched.

External Supply Inputs

In order to utilize the above inputs on the DSS 1.1 card, the external supply voltage which is used for the above signals must also be applied to the inputs $+U_L$ and $0V_L$, (pins 7 and 8 of connector X12).

4.1.3. Power Wiring

Follow the interconnection drawing for specific instructions on power wiring. Pay special attention to the following:

1. Wire grounds from servo amplifiers directly to the power supply. Do not "daisy chain" the ground wire from one amplifier to the next.
2. Wire grounds from each motor directly to its respective servo amplifier.
3. Use either twisted wires or a 4-wire cable for the motor power connections. Make this line as short as possible.
4. If a supplementary capacitance unit is used, make the connecting wire as short as possible.
5. Carefully follow local codes for fusing and grounding.

4.2. Step-by-Step Installation Instructions

Refer to the OEM interconnects and to the interconnect drawing in Appendix C.

1. Determine where each component is to be mounted on the panel. See paragraph 4.1.1 for details.

2. Mount the modules to the panel.

   Use 6mm or 1/4" screws for the top keyhole and the bottom mounting slots.

3. Mount bus bars to connect all L+ terminals together and all L- terminals together. Use an 8mm hex nut driver.

   Recommended tightening torque: 26 lb-in.

   CAUTION: Use locking nuts or lock washers provided. Do not over-torque nuts or damage may result.

5. Install X1 wire "ribbon" cable between the power supply and the first amplifier. Connect a cable from each servo amplifier to the next amplifier. Note that the black wire is towards the bottom. When installing DDS amplifiers with KDV power supplies, or if DDSs and KDSs, KDAs or other cold modules are configured together, 12 pin to 16 pin or 16 pin to 12 pin ribbon cables may be required. These cables are supplied with the specified amplifier accessory kits.

6. Install a terminating plug on the last amplifier, i.e., the one furthest from the power supply. The terminating plug is supplied with the power supply accessory kit.

   Note: When any cold modules such a KDSs, KDAs, etc. are used, the terminating plug contains a resistor covered with heat shrink tubing. The plug should be mounted with the resistor on top (pins 2 & 3).

7. Connect the 3-phase wires to terminal lugs L1, L2, and L3. The 3-phase inputs on certain power supplies are phase sensitive. In order to prevent damage to the unit, see the appropriate power supply manual for correct phasing. The incoming 3-phase must be ground referenced as specified in section 3.8.

   Recommended tightening torque: 44 lb-in.

8. Install grounding wires from the power supply to each amplifier. Do not daisy chain the grounds from amplifier to amplifier.

   Recommended tightening torque: 26 lb-in.

9. Connect the motor power cable from each motor to its respective amplifier on terminals A1, A2, and A3. ***WARNING: These connections are phase sensitive and wiring should follow the interconnect drawing exactly.*** It is very important to connect each motor ground to its own amplifier.

   Do not run cables over the bus bars. Run cable wires out of the top or bottom of the unit to avoid the bus bars.

   Recommended tightening torque for A1, A2, and A3: 44 lb-in.
   Recommended tightening torque for GND Nut: 26 lb-in.

10. Connect the motors high resolution feedback cable to the DB15 connector, X4, near the bottom right side of the DDS. If a second feedback device is being used, (such as a linear encoder), an additional DLF 1 card will be required. Refer to the interconnect drawings in Appendix C and the cable and connector descriptions in Appendix D for wire color to terminal designations.

11. Connect the servo amplifier signal wiring following one of the procedures in the following sections, depending on drive configuration, (which plug-in cards are used). In addition, the phoenix terminal, X6, must be wired for the thermal switch and the brake. The wires for the motor thermal switch are contained in the motor power cable and are connected to pins 1 and 2 of X6. The thermal wires are not polarity sensitive. When wiring the brake, an external +24V supply is required, with +24V connected to pin 3 and its 0 reference to pin 6 of X6. The Brake + wire from the motor power cable is then wired to pin 4, and Brake - to pin 5 of the X6 connector. (See Appendix D for cable descriptions and Appendix C for DDS 2.1 Interconnect Drawing).

12. Connect the power supply signal wiring. See the corresponding power supply manual for more details.

13. If an inductor is used with the KDV, remove the Plexiglas cover over X28 and remove the jumper wire from the terminal lugs on the top of the unit using a 10mm hex nut driver. Install the inductor in place of the jumper. Re-attach the Plexiglas cover.

    Recommended tightening torque: 44 lb-in.

4.3. DSS 1.1 SERCOS Interface Card

1. Before handling the DSS 1.1 Card, make sure that you are grounded as static electricity discharge can cause damage to the surface mount devices.

2. Make sure the DSS 1.1 Card is plugged into the first slot on the lower left of the DDS 2.1, (slot U1). This is the only acceptable slot and is designated as the main communication slot. No other communication cards should be in any other slots. (See configuration section of the DDS 2.1 Selection Guide for acceptable card combinations). Take care not to bend the connector pins when inserting this card. When the connector is properly aligned, the card will fit smoothly into place.

Warning: *Do not force plug-in cards into slots. Damage to the connectors may result.*

3. Once the card is inserted, connect the fiber optic cables as shown below.
Switch S3 is set to "1" and switch S2 is set to "7

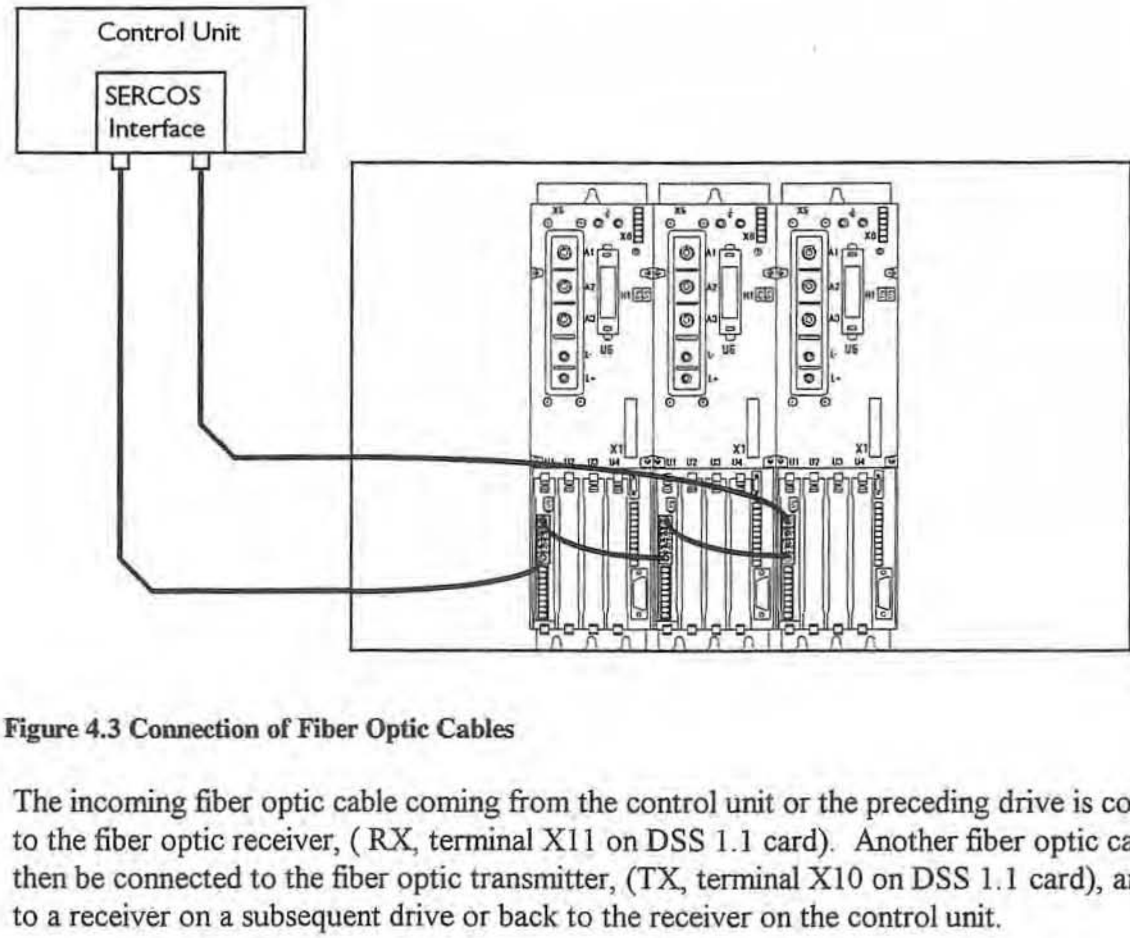


Figure 4.3 Connection of Fiber Optic Cables

The incoming fiber optic cable coming from the control unit or the preceding drive is connected to the fiber optic receiver, (RX, terminal X11 on DSS 1.1 card). Another fiber optic cable must then be connected to the fiber optic transmitter, (TX, terminal X10 on DSS 1.1 card), and routed to a receiver on a subsequent drive or back to the receiver on the control unit.

Warning: *When tightening the fiber optic connectors, a torque of 7 in-lbs, or .8 NM must not be exceeded. Damage to the connectors will result. (Refer also to F-SMA IEC 86B)*

When connecting the SERCOS ring, all components to be operated by the Master Control Unit must be connected on the fiber optic ring. The fiber optic ring must make a complete loop back to the Master Control Unit.

4. Each device on the SERCOS ring has a unique address, (with the exception of the Master Control Unit). This address is a number between 01 and 99, (SERCOS allows up to 254). The address "00" is reserved as a "null" address in which the unit is connected but is not active in the SERCOS ring. A null device must still be active in repeater mode, in which it repeats the incoming data stream at its receiver to the transmitter, maintaining communications. In order to set the address on a DSS 1.1 card, the high address must be set on selector switch S3 and the low address on switch S2. For example, a SERCOS address of "17" corresponds to switch S3 setting of "1" and switch S2 setting of "7".

4.4. DAE 1.1 Analog Interface Card with Incremental Encoder Emulator

1. Before handling the DAE 1.1 Card, make sure that you are grounded as static electricity discharge can cause damage to the surface mount devices.

2. Make sure the DAE 1.1 Card is plugged into the first slot on the lower left of the DDS 2.1, (slot U1). This is the only acceptable slot and is designated as the main communication slot. No other communication interface cards should be in any other slots. (See configuration section of the DDS 2.1 Selection Guide for acceptable card combinations). Take care not to bend the connector pins when inserting this card. When the connector is properly aligned, the card will fit smoothly into place.

   Warning: *Do not force plug-in cards into slots. Damage to the connectors may result.*

3. Terminal X13 on the DAE 1.1 card contains the signal wiring terminations. This terminal uses a 10 pin miniature Phoenix plug-in connector. An external 24V, 100mA power source is required for this card and is input at pins 8 and 9 on the X13 connector. For additional information on DAE 1.1 signal wiring, refer to the interconnect drawing in Appendix C.

4. The incremental encoder emulator provides a representation of the position of the rotor or the load. This uses a 15 pin sub miniature D-Shell connector and is designated as X14 on the DAE 1.1 card. For the correct pinouts of this connector, see Appendix C.

4.5. Feedback Input Cards

There are three feedback input cards currently available, DEF 1.1, DLF 1.1 and DZF 1.1.

1. Before handling the feedback cards, make sure that you are grounded as static electricity discharge can cause damage to the surface mount devices.

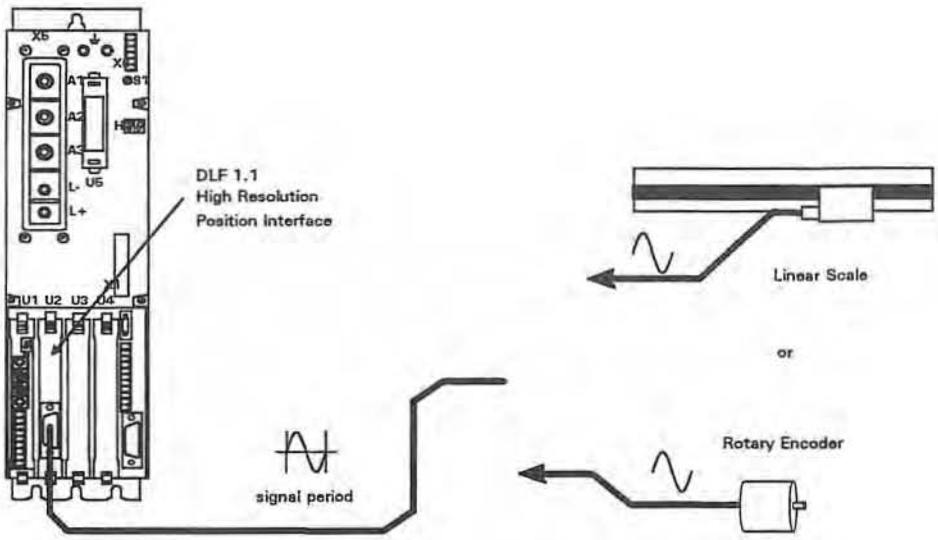
2. These cards may be input into any one of the remaining three slots. Take care not to bend the connector pins when inserting these cards. When the connector is properly aligned, the card will fit smoothly into place.

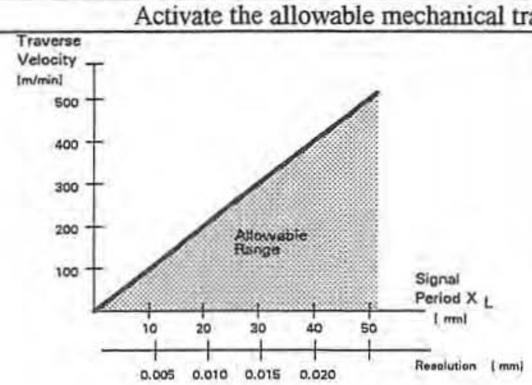
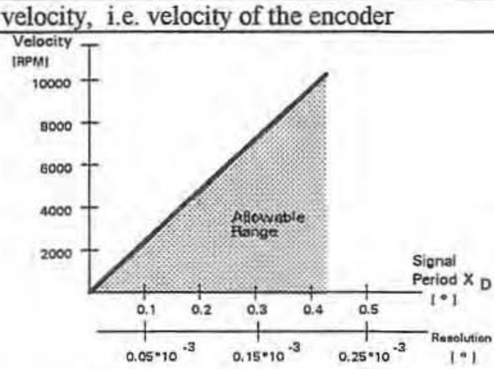
   Warning: *Do not force plug-in cards into slots. Damage to the connectors may result.*

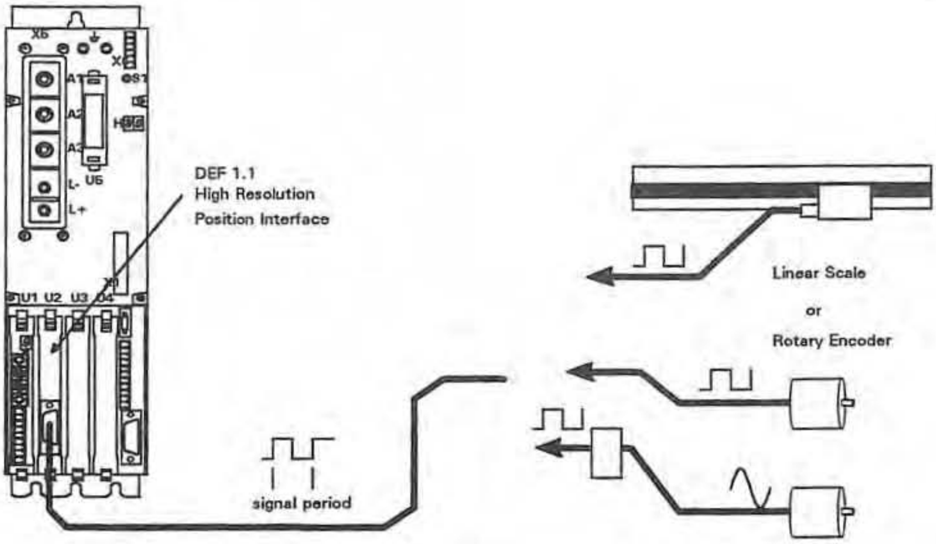
3. On each of these cards, there is a 15 pin sub miniature D-Shell connector for input from an external feedback device. For more information on the pinouts and usage of these cards see section Appendix C.

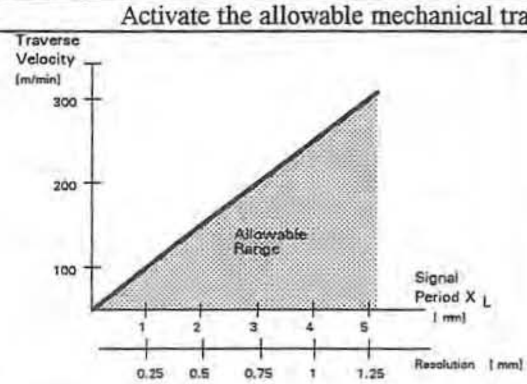
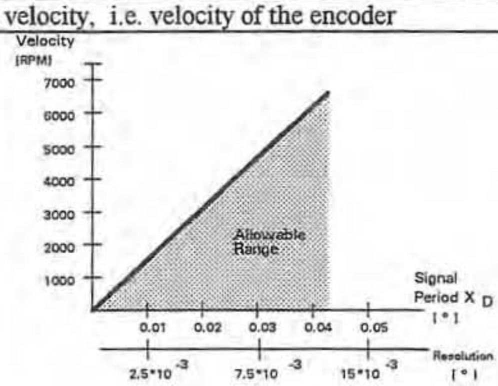
4. When using the DLF 1.1 card, (Linear Encoder Analog Position Input Card), and a Heidenhain linear scale, it may be necessary to use a DGV 1.1 Line Driver for cable lengths longer than 75 feet, (30 meters).

Application specifications for the feedback connections are given on the following pages. For more detailed specifications of the feedback input cards, see Appendix A.



	Linear Scale	Rotary Encoder
Signal Period	Corresponds to a distance of X_L µm	Corresponds to an angle of X_D °
2048 time resolution	$\text{Resolution } [\mu m] = \frac{X_L\,[\mu m]}{2048}$	$\text{Resolution } [°] = \frac{X_D\,[°]}{2048}$
	Maximum Traverse Velocity $V_{max}\left[\frac{m}{min}\right] = X_L[\mu m]\times 10^{-4}\times(150000\times 60)\left[\frac{1}{min}\right]$	Maximum Velocity $n_{max}[RPM] = \frac{X_D[°]}{360°}\times(150000\times 60)\left[\frac{1}{min}\right]$
	Activate the allowable mechanical traverse velocity, i.e. velocity of the encoder	
Maximum Velocity (Velocity at the max. input freq. of 150 KHz)		



	Linear Scale	Rotary Encoder
Signal Period	Corresponds to a distance of X_L µm	Corresponds to an angle of X_D °
2048 times resolution	$\text{Resolution } [\mu m] = \frac{X_L\,[\mu m]}{4}$	$\text{Resolution } [°] = \frac{X_D\,[°]}{4}$
	Maximum Traverse Velocity $$V_{max}\left[\frac{m}{min}\right] = X_L[\mu m]\times 1\ [MHz]\times 60$$	Maximum Velocity $$n_{max}[RPM] = \frac{X_D[°]}{360°}\times 1\times 10^6[Hz]\times 60$$
	Activate the allowable mechanical traverse velocity, i.e. velocity of the encoder	
Maximum Velocity (Velocity at the max. input freq. of 150 KHz)		

4.6. Operation of the Mechanical Brake

When a mechanical brake is installed in a MDD motor, the DDS 2.1 controls the brake so that the brake becomes engaged when the motor no longer has torque or in a situation where system power is lost.

The timing diagram in fig 3 describes the operation of the brake as it relates to drive enable, (RF).

NOTE: The mechanical brake of an MDD motor should not be used as an operational brake. The brake rotor disk can only withstand approximately 20000 motor revolutions against a closed brake before wearing out.

The control of the mechanical brake depends upon the Error Reaction Mode selected in the DDS 2.1.

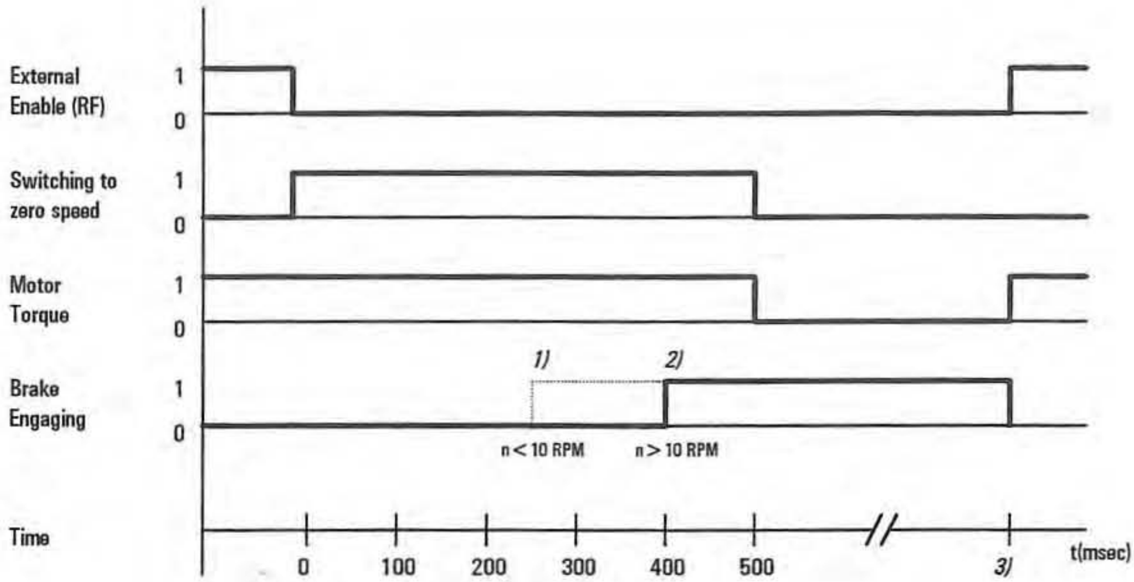
4.6.1. SERCOS Brake Control

When using the SERCOS Interface, these signals are controlled via the bit "Drive On" in the Master Data Telegram (MDT). (See Section 2.1 SERCOS Interface Specifications and IDNS-0-0134 for more details)

NOTE: In the case where the bit "Drive Enable" is changed from a "0" to a "1", (immediate switching off of the torque), the brake is immediately switched on. This sequence should only be performed when the motor speed is at 0 RPM, since the possibility of damaging the brake exists.

4.6.2. Analog Brake Control

When using an analog interface card, the brake is controlled via the RF enable signal. This corresponds to connector 13, terminal 4 on the DAE 1.1 card and connector 15, terminal 4 on the DAA 1.1 card.



1) Braking condition when motor velocity is under 10 RPM.

2) Braking occurs after 400 msec, when the motor velocity is over 10 RPM

3) The brake is released at the same time RF enable is applied

NOTE: 100 msec after the brake is engaged, the motor torque is removed.

CHAPTER 5. STARTUP

5.1. Analog DDS 2.1 Startup

Section 5.1 is the startup procedure for analog DDS 2.1's. These are DDS's which use a standard ± 10V command signal. They are identified by the letters "DA##" at the end of the DDS 2.1 typecode, where the "##" is a 2 digit number designating the configuration type. (See Appendix E for more information on typecodes. See also, the DDS 2.1 Selection Guide.) If you have a SERCOS drive, designated by "DS##", skip Section 5.1 and go to Section 5.2, SERCOS Startup.

5.1.1. Equipment Requirements

- Analog or Digital Multimeter (20,000 Ohm per Volt or greater sensitivity)
- Oscilloscope
- Battery box with an adjustable command signal from -10V to +10V DC

Warning: Do not connect the grounded lead of the oscilloscope to either of the DC bus bars. Both of these conductors are at a high voltage with respect to ground. Serious equipment damage and/or personal injury may result.

5

5.1.2. Pre-Power Checks

Make sure power is not applied to the system and perform these checks for each servo drive and power supply.

1. Check for the correct program modules. See appendix H.

2. Ensure that external wiring agrees with the wiring diagram. Check for open circuits, short circuits and crossed connections. Refer also to Section 3.3 Analog Inputs for descriptions of analog input signals.

3. Check the external wiring to ensure that the wires are securely held in the terminals and that the bus bars are securely tightened down. Poor contact due to loose screws may result in severe damage to the drives.

4. Check for compliance with local wiring codes and safety regulations. Pay special attention to grounding, wire sizing and fusing.

5. Check for proper shielding of the signal lines. The shield must be connected to ground at one end only.

6. Motor and drive grounding must conform exactly to the Indramat interconnect drawings. Each motor must be grounded to its own respective drive module. Each drive must also be individually grounded back to the power supply unit. (Do not daisy chain the drive grounds).

7. Verify that the power supply and transformer ratings agree with the incoming line voltage. Check both 3-phase and single phase control voltages.

5.1.3. Power On Checks

Before providing any power, perform the following steps:

1. Disconnect the velocity command signal lines from terminals E1, E2.

2. Disconnect the drive enable signal, RF.

3. Uncouple the motor from the mechanical load. If this is impossible, then make sure that the motor is in the center of its travel distance. Also, make sure that all safety limit switches are wired in and operational.

4. Remove fuses from the 3-phase supply or ensure that the 3-phase voltage will not be present for first power up.

Apply single phase control power to the system and perform the following checks:

1. Check the internal fans on the bottom of the drives for proper operation. Make sure these are unblocked.

2. Check the +24V and ±15V DC on the power supply with respect to 0_{VL} and 0_{VM} respectively.

3. Verify that the emergency stop circuit is functional.

4. If the fuses from the 3-phase power have been removed, check that the main contactor functions properly. (It is important that the 3-phase fuses are removed for this test).

5. Check the +24V external voltage for the brake.

6. Check the diagnostic display for a good diagnostic. Refer to Chapter 6 Maintenance and Troubleshooting.

5.1.4. Applying Main Power and Moving the Axis

1. Turn single phase power to the system off.
2. Leave mechanical load uncoupled from the motor shaft. Reconnect all missing power connections or replace fuses.
3. Connect a battery box as shown in the figure below.

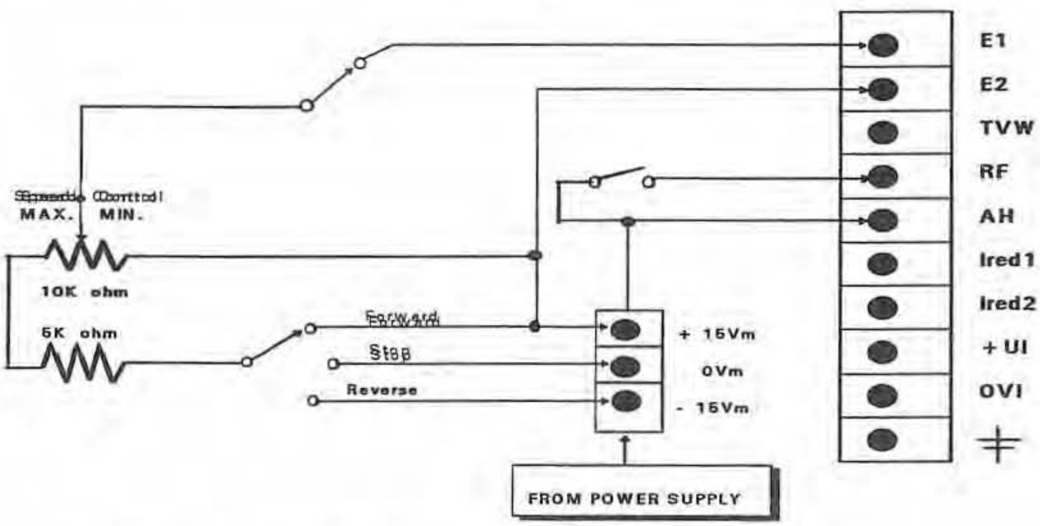


Figure 5.1 Battery Box

It is important that the Emergency Stop circuit is functional for the following steps.

4. Apply single phase power to the servo system. The diagnostic "bb" should appear.
5. Measure the command voltage coming from the battery box and make sure this is set to 0V. The RF enable should also be at 0V with respect to 0_{VM}.
6. Energize the main 3-phase power contactor. "Ab" should appear on the display.

7. The bus voltage should now be between 275VDC and 345VDC for a TVM power supply or at 320 VDC for the TVD power supply with a regulated bus.

8. Enable the drive by applying voltage to the RF input, (closing the enable switch as shown in the Battery Box illustration). Slowly turn the speed pot on the battery box which will provide a small velocity command signal to the DDS. The motor should run at a slow steady speed. By reversing the polarity, the motor should run in the reverse direction.

9. Check the scaling of the velocity command signal against the speed sensitivity configured in the drive. (Refer to Section 3.8.4 Command Value Scaling).

5.1.5. Checking Load Torque

Once again turning power off, the motor should be coupled to the load. Continue to use the battery box to provide the velocity command signal.

In the following steps, the motor current will be used as an indication of load torque since they are directly proportional. The motor current is measured via one of programmable outputs, AK1 or AK2. Current Command Value should be selected in the Operation Modes, Scaling menu over the RS232 interface, (see Section 3.8 Operation Modes).

Perform the following steps:

1. Determine the motor torque at a very slow speed (approximately 5 inches per minute for conventional axis feed applications. The current required at this speed should not exceed 60% of the rated motor current.

   Measured Speed:_______ Measured Current:______

2. Determine the motor torque at the rapid traverse speed of the servomotor. The current required at this speed should not exceed 75% of the rated peak motor current.

   Measured Speed:_______ Measured Current:______

If the measured torques are higher than expected, check the mechanics to make sure there is no binding or excessive load conditions. Also check the motor sizing for the application. (Refer to the DDS 2.1 Selection Guide).

5.2. SERCOS Startup

5.2.1. Pre-Power Checks

Make sure power is not applied to the system and perform these checks for each servo drive and power supply.

1. Check for the correct program modules. Make sure that SERCOS software is installed in the program module. Refer to appendix H.

2. Ensure that external wiring agrees with the wiring diagram. Check for open circuits, short circuits and crossed connections. Refer also to Section 4.3. DSS 1.1 SERCOS Interface Card for descriptions of the SERCOS inputs.

3. Check the external wiring to ensure that the wires are securely held in the terminals and that the bus bars are securely tightened down. Poor contact due to loose screws may result in severe damage to the drives.

4. Check for compliance with local wiring codes and safety regulations. Pay special attention to grounding, wire sizing and fusing.

5. Check for proper shielding of the signal lines. The shield must be connected to ground at one end only.

6. Motor and drive grounding must conform exactly to the Indramat interconnect drawings. Each motor must be grounded to its own respective drive module. Each drive must also be individually grounded back to the power supply unit. (Do not daisy chain the drive grounds).

7. Verify that the power supply and transformer ratings agree with the incoming line voltage. Check both 3-phase and single phase control voltages.

5.2.2. Power On Checks

Before performing the following steps, check the startup procedure of the SERCOS control unit. Many of the diagnostics appearing on the H1 display may also be shown with more descriptive text over the control unit user interface.

1. Disconnect the velocity command signal lines from terminals E1, E2.

2. Disconnect the drive enable signal, RF.

3. Uncouple the motors from their mechanical loads. If this is impossible, then make sure that each of the motors are in the center of their travel distance. Also, make sure that all safety limit switches are wired in and operational.

4. Remove fuses from the 3-phase supply or ensure that the 3-phase voltage will not be present for first power up.

Apply single phase control power to the system and perform the following checks:

1. Check the internal fans on the bottom of the drives for proper operation. Make sure these are unblocked.

2. Check the +24V and ±15V DC on the power supply with respect to 0_{VL} and 0_{VM} respectively.

3. Verify that the emergency stop circuit is functional.

4. If the fuses from the 3-phase power have been removed, check that the main contactor functions properly. (It is important that the 3-phase fuses are removed for this test).

5. Check the +24V external voltage for the brake.

6. Apply the single phase power to the drives and the control unit. The control unit can then start the SERCOS initialization process. If an address is set incorrectly, the drive with the incorrect address will switch between -0 and -1 on the H1 display, and all drives following the incorrect drive on the ring will display -0. If all drives display "-0", make sure that the fiber optic ring is completely closed. (Refer to Chapter 4 for correct installation procedure).

7. After the addresses are set correctly, the drive should advance to communication phase 2, which the drive acknowledges with a "-2" on the display. All the SERCOS timing parameters must be sent to the drive by the control unit in this phase. Once the system is in communication phase 2, the operator may access and change SERCOS parameters. (Note that some parameters are read only and may not be changed). Any invalid IDN's which are necessary during communication phase 2 can be found in a list under IDN S-0-0021.

8. Before continuing, set IDN's S-0-0049 and S-0-0050, the positive and negative position limit values to "0" in each drive. This ensures that the axes will not move when they are in communication phase 4.

9. Once all the timing parameters have been set correctly by the control unit, the system advances to communication phase 3, which is acknowledged with a "-3" on the display. If this then turns to a blinking "32", you must check IDN S-0-0095 for the correct diagnostic.

(Refer also to Chapter 6, Diagnostics). In this communication phase, all remaining parameters are loaded. If parameters are considered invalid by the drive, the drive will give an appropriate error. All invalid IDN's in comm. phase 3 can be found in a list under IDN S-0-0022.

10. When the system is advanced to communication phase 4, the drives can now be enabled and run under normal operation. All parameters are found to be acceptable for the drive. This does not mean that they are necessarily correct for the application.

5.2.3. Applying Main Power and Moving the Axis

1. Turn single phase power to the system off.

2. Leave the mechanical loads uncoupled from the motor shafts. Reconnect all missing power connections or replace fuses.

It is important that the Emergency Stop circuit is functional for the following steps.

3. Apply single phase power to the system and advance it to communication phase 4. Make sure the drive enable is turned off for all the axes.

4. Energize the main 3-phase power contactor. "Ab" should appear on the display. The bus voltage should now be between 275VDC and 345VDC for a TVM power supply or at 320 VDC for the TVD power supply with a regulated bus.

The remaining steps should be done for each drive individually.

5. Enable the drive in the control unit. The drive should come up with torque and the brake should be released. At this point it is not possible to move the axis since the IDN's S-0-0049 and S-0-0050 position limits are set to "0". If all diagnostics are normal, proceed to set small values to these position limit parameters.

6. Begin to jog the axis slowly to determine the direction of motion. Once the direction is determined, (positive or negative), set all scaling parameters appropriately.

7. Once all the drives are operating normally, set the position limits to their desired location and perform a homing of all the axes.

5.2.4. Homing

When the axes are first switched on and they have no absolute position orientation, the axes position measuring systems must be aligned so that they have a relationship to a known machine position before normal measuring operations takes place. These alignments take place during the Homing Procedure.

- The operation of the homing procedure is shown in Figure 5.2 Homing Procedure using the Motor Feedback, with position measurements done via the motor encoder. Figure 5.3 Homing Procedure using an External Feedback, again shows homing, except with position measurement done by an external linear encoder or rotational encoder mounted directly on the slide. The order of events is discernible from these figures.

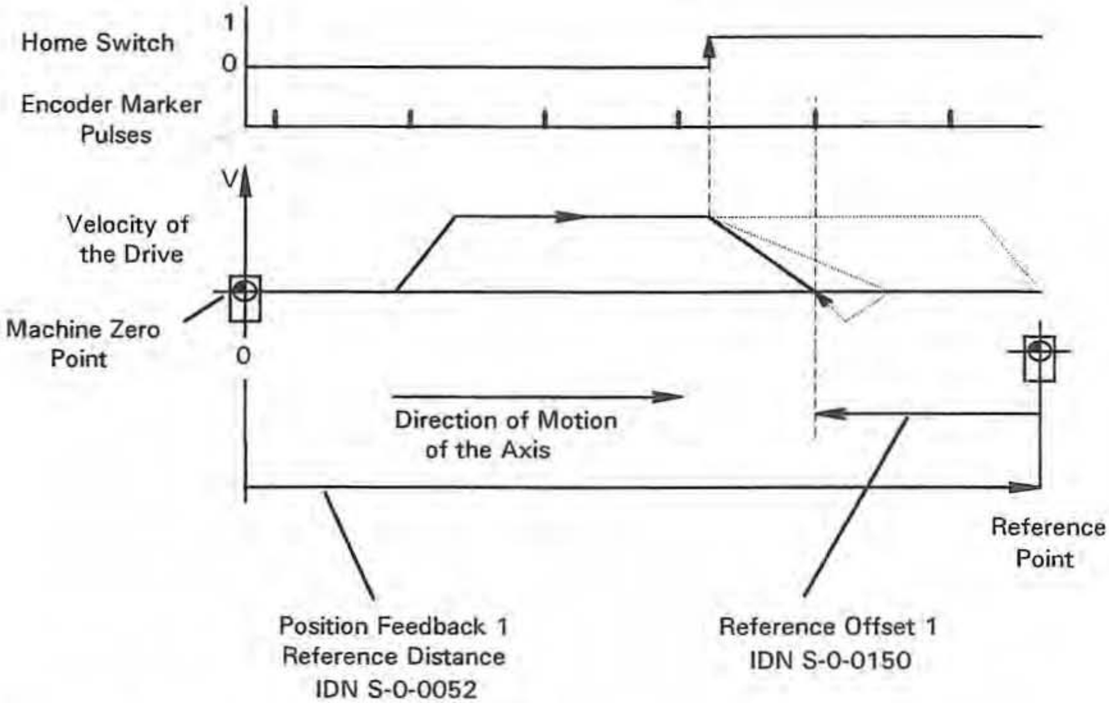


Figure 5.2 Homing Procedure using the Motor Feedback

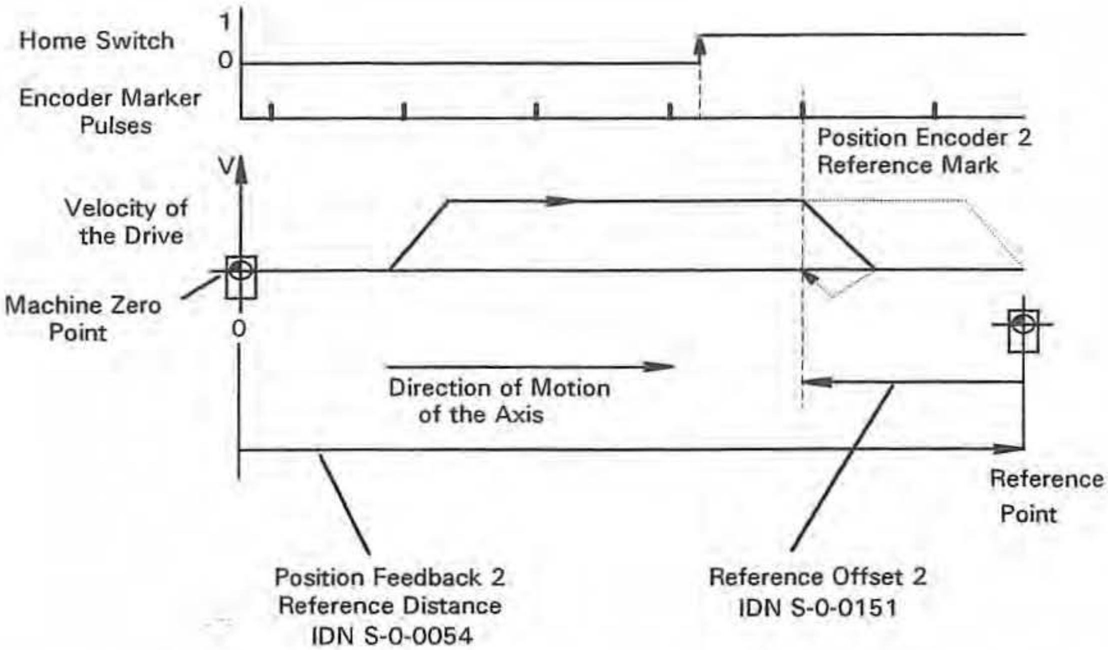


Figure 5.3 Homing Procedure using an External Feedback

- Before actually homing, the home switch testing function should be performed.
- The process of the homing procedure is described in the following figures:

  Figure 5.2 Homing Procedure using the Motor Feedback - By "incrementally " measuring position from the motor encoder

  Figure 5.3 Homing Procedure using an External Feedback - By "incrementally " measuring position from an external encoder mounted at the load with evaluation of the home switch

- The related parameters are described as follows:

S-0-0041 Homing Velocity

The Homing Velocity is the velocity which the motor will operate at during drive controlled homing.

S-0-0042 Homing Acceleration

The Homing Acceleration is the acceleration which the motor will operate at during drive controlled homing.

S-0-0147 Homing Parameter

This parameter defines the setup for the drive controlled homing procedure.

S-0-0150 Reference Offset 1

This parameter contains the distance between the Position Feedback 1 - Reference Distance, (IDN S-0-0052), and the home position as determined by the respective marker pulse of position feedback 1.

S-0-0151 Reference Offset 2

This parameter contains the distance between the Position Feedback 2 - Reference Distance, (IDN S-0-0054), and the home position as determined by the respective marker pulse of position feedback 2.

S-0-0052 Position Feedback 1 - Reference Distance

This parameter contains the distance from the machine zero point to a fixed reference point as measured by position feedback 1, (motor encoder).

S-0-0054 Position Feedback 2 - Reference Distance

This parameter contains the distance from the machine zero point to a fixed reference point as measured by position feedback 2, (external encoder).

S-0-0148 Drive Controlled Homing Procedure Command

When the Master sets and enables this command, the drive automatically starts a drive internal position control and accelerates to the homing velocity, (IDN S-0-0041), with an acceleration defined by the homing acceleration parameter, (IDN S-0-0042). The drive resets the bit "Position Feedback Status", (IDN S-0-0403). All changes within the cyclic command, (e.g., velocity command value), are ignored by the drive while the procedure is active.

Once the home switch has been activated, the drive decelerates, (at a rate defined by IDN S-0-0042), and stops on the following marker pulse. The drive then sets bit "Position Feedback Status", (IDN S-0-0403).

The control unit reads the position command value of the drive, (IDN S-0-0047), via the service channel, and sets its own position command value to the same value. Once this is complete, the procedure command is canceled by the control unit, and the drive once again follows the cyclic command values sent by the control unit.

S-0-0400 Home Switch

This parameter is used to assign an ID Number to the home switch. Bit 0 reflects the state of the home switch.

P-0-0020 Displacement of the Home Switch

During Drive Controlled Homing, the home switch is evaluated by the drive. An optimal location exists from the relative position where the home switch signals to the marker pulse of the motor encoder. In order to facilitate in the adjustment during the first start-up, the distance from the home switch dog to the ideal point can be displayed with this parameter. The value is dependent on the programmed position scaling type, (see S-0-0076), and is displayed in [mm] or [°].

For a more detailed description of these parameters, see Chapter 2.

CHAPTER 6. MAINTENANCE AND TROUBLESHOOTING

6.1. DDS 2.1 Diagnostic Descriptions for the H1 Display

This section describes the diagnostics which appear on the 2 digit, 7-segment display, (H1) on the front face of the DDS 2.1. This display shows normal operating diagnostics as well as error diagnostics.

bb **Operation Ready**

The drive is ready to switch on main power, (3 phase).

Ab **Drive Ready**

Control voltage and main power are present, (DC bus voltage is present). Drive is ready to be enabled.

AF **Drive Enabled**

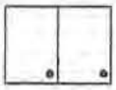
Drive has all power up and has been enabled. The drive will follow a commanded input over SERCOS or the analog input, depending on the drives configuration.

AH **Drive Halt**

The drive will stop the motor with its maximum available torque, (or the torque selected by the current reduction via the RS232 interface, see section 3.11 Torque (Current) Reduction. The drive will then maintain zero velocity, ignoring the commanded input, and remain in a closed velocity loop. This is only applicable when using the analog interface configuration.

AS **Safety Interlock**

The power section of the drive is disabled when the AS input is activated. This allows select individual axes to be shut down while all other axes remain active. See page 4-4 for more details.



Watchdog

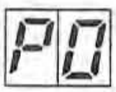
The processor in the drive is locked up

Possible Causes:

1. The DSM Software module is not plugged in or is defective
2. The processor is defective

Possible Solutions:

1. Insert missing DSM module in the U5 slot on the front of the DDS, or exchange the module if it is defective.
2. Exchange the drive if the software module is OK.



Communication Phase 0

The SERCOS Communication is in Phase 0, which means that the Master is attempting to close or has not yet closed the ring. The Master sends out a stream of MST's, and determines that the ring is closed after it sees 10 consecutive MST's come back off the ring.

Possible Causes:

1. The Master is in the process of closing the ring.
2. The Master is down and is not attempting to close the ring.
3. The fiber optic ring is open, (i.e. a fiber optic connector is not attached).
4. The fiber optic connectors are contaminated with dirt, or fiber optic cables are damaged.
5. The fiber optic ring configuration is not correct.

Possible Solutions:

1. Check the status of the control unit
2. Check fiber optic cables and connectors for proper connection and to insure none are damaged or dirty

P1

Communication Phase 1

When the SERCOS Ring is in Phase 1, it is checking the addresses and the physical configuration of the ring.

Possible Causes:

1. The Master is in the process of checking the ring.
2. A drive address is set incorrectly.

Possible Solutions:

1. Check status of the control unit.
2. Check the addresses on all drives. 2 drives may not have the same address.

P2

Communication Phase 2

When the SERCOS Ring is in Phase 2, the master is testing and obtaining information for the communication timing parameters and it configures the system to run in its normal operation mode. These timing parameters are required in order to progress to Communication Phase 3. The Master may also stay in this phase to do any other parameterization, and this is sometimes called parameter mode. All communications done in this phase take place over the service channel and only one drive is communicated to at one time.

Possible Causes:

1. System is in Parameter Mode.
2. Master is still processing timing parameters (this can take up to 5 sec).
3. One of the drives has invalid or incomplete timing parameters.

Possible Solutions:

1. Check the status of the control unit.
2. IDN S-0-0095 contains a diagnostic text message for the current drive diagnostic. Many times, this diagnostic message is automatically displayed by the control unit. Check this diagnostic message. If it reads "201 Parameter Set Incomplete", you can check IDN S-0-0021 for a list of invalid or incomplete parameters required during Communication Phase 2. For more information, see "201" error description in this chapter and also IDN S-0-0021.

P3 Communication Phase 3

In Communication Phase 3, the Master must load all remaining parameter data for the drive to run in normal operation mode. This parameter data is typically application specific, (i.e. telegram type, velocity scaling, position scaling, etc.) There are certain parameters which must be correct in order to proceed to Communication Phase 4. In this phase, all communication parameters are correct and working, and all drives on the ring are communicated with every cycle.

Possible Causes:

1. System is in Parameter Mode.
2. Master is still processing application parameters.
3. One of the drives has invalid or incomplete application parameters.

Possible Solutions:

1. Check the status of the control unit.
2. IDN S-0-0095 contains a diagnostic text message for the current drive diagnostic. Many times, this diagnostic message is automatically displayed by the control unit. Check this diagnostic message. If it reads "201 Parameter Set Incomplete", you can check IDN S-0-0022 for a list of invalid or incomplete parameters required during Communication Phase 3. For more information, see "201" error description in this chapter and also IDN S-0-0022.

01 MST Failure

The Master Synchronization Telegram was missing in two consecutive SERCOS cycles.

Possible Causes:

1. Optical losses in the cable are too high. (Cable possibly too long).
2. Fault occurred in the control unit.
3. Noise in the fiber optics.
4. Noise within the SERCOS Interface.

Possible Solutions:

1. Check the status of the control unit.
2. Examine all fiber optic connections. (Make sure the ends of the cables are not contaminated).
3. Measure the losses of the fiber optic cables. Check the length of the fiber optic cables.
4. Exchange SERCOS Interface boards.

02 MDT Failure

The Master Data Telegram was missing in two consecutive SERCOS cycles.

Possible Causes:

1. Optical losses in the cable are too high. (Cable possibly too long).
2. Fault occurred in the control unit.
3. Noise in the fiber optics.
4. Noise within the SERCOS Interface.

Possible Solutions:

1. Check the status of the control unit.
2. Examine all fiber optic connections. (Make sure the ends of the cables are not contaminated).
3. Measure the losses of the fiber optic cables. Check the length of the fiber optic cables.
4. Exchange SERCOS Interface boards.

03 Invalid Communication Phase

SERCOS Master is attempting to run in a non-permissible communication phase, (Phase > 4).

Possible Causes:

1. Error in SERCOS Master module in control unit.

Possible Solutions:

1. Check documentation for control unit or contact manufacturer.

04 Error Advancing Communication Phases

The prescribed sequence has not been followed in the advancing of the communication phases.

Possible Causes:

1. Error in SERCOS Master module in control unit.

Possible Solutions:

1. Check documentation for control unit or contact manufacturer.

05 Error Descending Communication Phases

The prescribed sequence has not been followed in the descent of the communication phases.

Possible Causes:

1. Error in SERCOS Master module in control unit.

Possible Solutions:

1. Check documentation for control unit or contact manufacturer.

06 Communication Phase Switched without Ready Message

The SERCOS Master attempted to switch communication phases without waiting for the ready signal from the drive.

Possible Causes:

1. Error in the control unit.

Possible Solutions:

1. Check documentation for control unit or contact manufacturer.

07 Switched to a Non-Initialized Operation Mode

An operation mode selected in one of the operation mode parameters is undefined.

Possible Solutions:

1. Check the operation mode parameters for defined modes.
2. The allowed operation modes are:

   - Torque Regulation
   - Velocity Regulation
   - Position Regulation with Feedback 1, (Motor Feedback)
   - Position Regulation with Feedback 2, (External Feedback)
   - Position Regulation with Feedback 1 without following error.
   - Position Regulation with Feedback 2 without following error.
   - Single Axis Move with following error.
   - Single Axis Move without following error.

18 Amplifier Over Temperature Shutdown

The power stage section of the drive has reached an excessively high temperature. This over temperature condition has followed diagnostic "50", Amplifier Over Temperature Warning which was present for more than 30 seconds. The drive immediately goes to a velocity of zero when this error occurs.

Possible Causes:

1. Insufficient heat dissipation in the cabinet.
2. Cabinet air conditioner or heat exchanger failed.
3. Drive fan blocked or inoperative.

Possible Solutions:

1. Check drive fan and replace drive if necessary.
2. Check cabinet air conditioner or heat exchanger for proper operation.
3. Check cabinet sizing.

19 Motor Over Temperature Shutdown

The motor has reached an excessively high temperature. This over temperature condition has followed diagnostic "51", Motor Over Temperature Warning in the drive, which was present for more than 30 seconds. The drive immediately goes into a shutdown mode according to parameter P-0-0007, Error Reaction when this error occurs.

Possible Causes:

1. Motor sizing incorrect, check application and motor sizing.
2. There is mechanical binding or excessive friction
3. The motor thermal connection is shorted or grounded.

Possible Solutions:

1. Check motor/drive sizing
2. Check mechanics
3. Check for proper motor thermal connection

21 Control Voltage Error

22 Motor Encoder Error

The motor feedback signals are monitored by the drive. If these signals are outside of their tolerances, this error message occurs and the power supply is switched off.

Possible Causes:

1. The motor feedback cable is defective or is not connected.
2. The motor feedback is defective

Possible Solutions:

1. Check the motor feedback cable and replace if necessary.
2. Check the motor feedback and replace the motor if necessary.

24 Over Current

One of the three phase currents has a value larger than 1.5 times the drives rated current.

Possible Solutions:

1. Check the current loop gain parameters.
2. Check the motor power cable and replace if necessary.

25 Over Voltage

The DC bus voltage has exceeded its maximum value, (V_{bus} > 475 VDC). The drive has disabled the torque on the motor in order to prevent damage to its power stage.

Possible Causes:

1. The energy being regenerated by a spindle motor on the same power supply may be too great.
2. The regeneration capabilities of the power supply may have been exceeded, resulting in damage to the power supply.

Possible Solutions:

1. Decrease the deceleration ramp in the spindle motor.
2. Check the power supply and replace if necessary. If replacement is necessary, check the sizing of the power supply for regenerated energy handling.

26 Under voltage

DC bus voltage has dropped below 200 V while the drive was enabled.

Possible Causes:

1. The main power was switched off before disabling the drive.
2. Fault occurred in the power supply.

Possible Solutions:

1. Check the logic in the power down sequence of the drive. The drive should be disabled before the main power, (3 phase), is brought down. If this error occurs due to the power down sequence, it may be cleared by bringing up main power and recycling the drive enable. (Drive enable must be off when reapplying power. Once power is up, drive may be enabled again.)
2. Check the power supply and replace if necessary.

28 Excessive Deviation

The drive is unable to follow the last commanded value and reacts according to the selected error reaction mode.

Possible Causes:

1. The acceleration capacity of the drive has been exceeded.
2. The axis is blocked.
3. Faulty gain parameters in the drive.
4. The Monitoring Window, IDN S-0-0159, is set incorrectly

Possible Solutions:

1. Check parameter S-0-0092, Bipolar Torque Limit Value, and set this value to its maximum permissible value which the application will allow.
2. Reduce the acceleration of the control unit.
3. Check mechanics and remove axis coupling.
4. Check drive gain parameters.
5. Check the Monitoring Window, IDN S-0-0159.

30 Software Over Travel Limit Exceeded, Shutdown

Possible Causes:

1. The drive has been commanded a value outside the traverse range of the axis.

Possible Solutions:

1. Check position limit values in IDN's S-0-0049 and S-0-0050.
2. Check software limits of the control unit.

32 Procedure Command Execution Error

Error conditions which occur during the execution of a procedure command are indicated by a collective diagnostic on the H1 display, (blinking 32). The details of the error may be found in IDN S-0-0095, Diagnostic.

33 External Power Supply Error

Different optional plug in modules may require an external supply for the on board inputs and outputs. If the required supply voltage lies outside of the permissible range, this error will be displayed.

Possible Solutions:

Check the external supply voltage. Voltage amplitudes and tolerances can be found in Appendix A.

34 Internal Software Synchronization Error

The communication between the drive processor and the SERCOS Interface module is distorted.

Possible Solutions:

1. Exchange SERCOS Interface module, DSS 1.1.
2. Exchange DDS 2.1 drive

35 Home Switch Position Error

The relative position of the home switch in relation to the marker pulse of the motor encoder is outside the permissible range.

Possible Solutions:

Parameter P-0-0020 contains the distance in which the home switch is currently positioned from its optimal position. Move the home dog by this distance. (See Figure 6.1 Positioning of the Home Switch.)

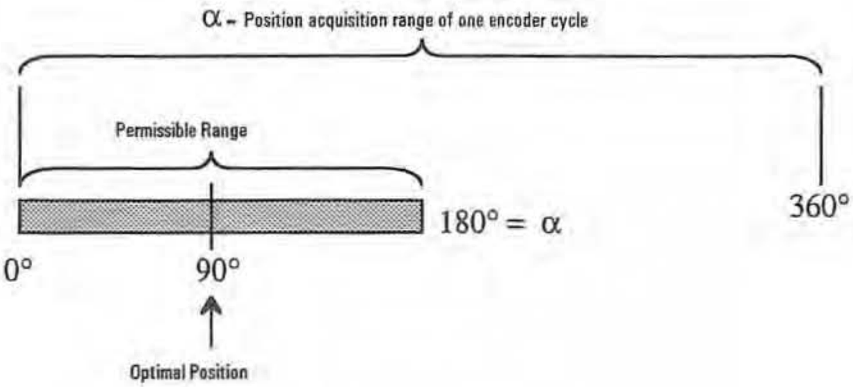


Figure 6.1 Positioning of the Home Switch

37 Excessive Position Command Value Difference

When a drive operates in closed position loop mode, the position command values are monitored. If the velocity derived by two successive position commands will exceed the value in the Bipolar Velocity Limit Value, IDN S-0-0091, this error will occur. The excessive position command value will then be stored in IDN P-0-0010. The last valid position command value will be stored in IDN P-0-0011.

(Another cause of this problem may be that the gear ratio is larger than 2047:1).

Possible Solutions:

1. Compare the Bipolar Velocity Limit Value (IDN S-0-0091) with the maximum programmed velocity value and adjust if necessary.

38 Absolute Encoder Power Interrupted

(Only for drive configurations RA02 and RS02 for MDD ≤ 041)

Possible Causes:

1. The motor feedback cable is either not connected or defective.

Possible Solutions:

1. Check feedback cable connection
2. Repair or replace feedback cable

39 Absolute Encoder Reference Lost

For new installations of an axis or after a power failure of the motor feedback, the drive looses its absolute position measurement (or reference).

Possible Solutions:

1. Home the axis using the absolute encoder homing procedure

41 Absolute Encoder Interface Defective

A hardware failure exists in the absolute encoder interface

Possible Solutions:

1. Exchange interface.

42 External Encoder Error : Signal Amplitude too Small

During the high resolution evaluation of the external position measuring system, analog signals are used. If the amplitude of these signals goes below an allowable limit value, this error message is displayed.

Possible Solutions:

1. Check external feedback cable.

43 Invalid Feedback Data - Communication Phase 2

In cyclic operation (Communication Phase 4), a motor encoder error, error 22, was encountered. This error is generated after the error in Phase 4 is cleared.

Possible Causes:

1. The feedback or feedback cable is defective.

Possible Solutions:

1. Check the feedback and feedback cable.
2. Reset error in Phase 2.

44 Over Travel Limit Switch Activated

Possible Causes:

1. The drive has been commanded a value outside the traverse range of the axis limit switch.

Possible Solutions:

1. Reset the error via the control unit.
   Bring the power supply voltage back up.
   Move the axis back within the limit switches.

6

45 External Encoder Error : Quadrant Error

A hardware error on the interface module is known by the connections of the external position feedback.

Possible Causes:

1. Feedback cable is defective.
2. Noise is being induced on the feedback cable
3. DLF 1.1 module is defective.

Possible Solutions:

1. Exchange the feedback cable.
2. Reroute the feedback cable away from high power cables, (i.e. motor power cables).
3. Exchange DLF 1.1 module.

46 External Encoder Error : Maximum Frequency Exceeded

The interface module in which the external feedback is connected to can only operate up to a set maximum frequency. This error is displayed when this maximum frequency has been exceeded

Possible Solutions:

1. Reduce velocity

47 Error Capturing the Marker Pulse of the External Encoder

Possible Causes:

1. DLF 1.1 Module is defective
2. Marker Pulse on the external feedback is defective

Possible Solutions:

1. Exchange DLF 1.1 Module
2. Check operation of external feedback device
3. Contact Indramat Service - Encoder may not be compatible with the electronics.

48 Absolute Encoder Battery Under voltage

The battery voltage of the absolute encoder interface module, (DPF 1.1), has fallen below its minimum value. It can still operate normally for approximately one week from the time the low voltage condition exists.

Possible Solutions:

1. Replace the battery as soon as possible.

50 Amplifier Over Temperature Warning

The heat sink in the drive has reached is maximum allowable temperature. The drive will continue to follow its commanded values for a period of 30 seconds. This allows the control unit to complete the machine cycle or go through a controlled shutdown. After 30 seconds, the drive goes into a shutdown mode according to parameter P-0-0007, Error Reaction.

Possible Causes:

1. Failure of the DDS internal fan.
2. Failure of the cabinets air conditioning or heat exchanger unit.
3. Incorrect air conditioner or heat exchanger sizing.

Possible Solutions:

1. In the case of a DDS internal fan failure, replace the DDS.
2. Check the functioning and efficiency of air conditioner or heat exchanger.
3. Check cabinet sizing.

51 Motor Over Temperature Warning

The motor has a thermal resistor built into the windings so that when the motors maximum operating temperature is exceeded, the DDS 2.1 is notified by a change in the resistor. When this motor over temperature condition occurs, the DDS 2.1 will continue to follow the commanded values for 30 seconds after which time a motor over temperature shutdown will occur. This allows the drive to bring the motor to a controlled stop if a motor over temperature condition occurs. After 30 seconds, the drive goes into a shutdown mode according to parameter P-0-0007, Error Reaction.

Possible Causes:

1. The motor is overloaded. The motor has run in a high torque condition for too long and has exceeded the allowable nominal torque rating.

Possible Solutions:

1. Check motor sizing.
2. If the motor and drive have been running this application for a long period of time without encountering a motor over temperature, check the machine for binding, excessive friction or excessive work loads.
3. Changes made to the machine, such as gearing changes or increased cycle times may cause this condition.
4. Check for motor oscillations. If oscillations exist, the inertia reflected to the motor may be too high. Check motor sizing or lower gains, i.e. position loop gains and velocity loop gains.

60 Bridge Fuse

The current in the power transistor bridge has exceeded the drives peak current by twice its rated value. When this occurs, the drive immediately switches off motor torque.

Possible Causes:

1. Short circuit in the motor cable
2. Power section of the drive is defective

Possible Solutions:

1. Check motor power cable and replace if necessary.
2. Check drive and exchange if necessary.

61 Earth Ground Connection

The sum of the phase currents is monitored. In normal operation, the sum total of the currents should be ≈0. If the sum of the currents is greater than $0.25 \times I_{nom}$, this fault is encountered.

Possible Causes:

1. Defective motor power cable.
2. Earth ground short exists in the motor.

Possible Solutions:

1. Check motor cable and motor for an earth ground short and replace if necessary.

67 Hardware Synchronization Fault

Possible Causes:

1. The pulse width modulator of the drive is synchronized with the SERCOS Master Synchronization Telegram via a phase control circuit. The exact synchronization is monitored and if synchronization is lost, this error message is displayed.

Possible Solutions:

1. Check the SERCOS transmissions.
2. Check the drive and replace if necessary.
3. Contact the control unit manufacturer.

68 Brake Fault

In an MDD motor with a mechanical brake, the drive controls the activation of the brake. In addition the brake current is monitored. If the brake current lies outside of the permissible range, this error will occur.

Possible Causes:

1. The power supply voltage for the brake is not properly connected or is outside it tolerance values, (+24V ±10%).
2. An open exists in the motor power cable or there is a bad connection, (leads reversed?).
3. Brake is defective.
4. Drive is defective.

Possible Solutions:

1. Check brake power supply.
2. Check motor power cable.
3. Check motor.
4. Check drive.

69 ±15 Volt Error

The drive internally monitors the ±15 V supply voltage for any distortion.

Possible Causes:

1. Defective control voltage ribbon cable.
2. Defective power supply.

Possible Solutions:

1. Check the control voltage ribbon cable and the X1 connector on the drive. Make sure there are no broken pins in this connector. Replace the ribbon cable if necessary.
2. Check the power supply module. Replace if necessary.

70 +24 Volt Error

The drive internally monitors the +24 V supply voltage for any distortion.

Possible Causes:

1. Defective control voltage ribbon cable.
2. Power supply 24V is overloaded.
3. Defective power supply.

Possible Solutions:

1. Check the control voltage ribbon cable and the X1 connector on the drive. Make sure there are no broken pins in this connector. Replace the ribbon cable if necessary.
2. Check possible external loading of 24V or possible shorting of wires.
3. Check the power supply module. Replace if necessary.

71 +10 Volt Error

The power supply voltage for the current sensors is distorted.

Possible Causes:

1. Defective drive.

Possible Solutions:

1. Replace drive.

72 +8 Volt Error

The power supply voltage for the encoder system is distorted.

Possible Causes:

1. Short circuit in motor feedback cable or external feedback cable.

Possible Solutions:

1. Check and replace feedback cables if necessary.

73 Driver Stage Power Supply Fault

The power supply voltage for the driver stage is distorted.

Possible Causes:

1. Defective drive.

Possible Solutions:

1. Replace drive.

76 Absolute Encoder Error

The last absolute position before power down does not correspond to the current position.

Possible Causes:

1. The feedback position is stored when powering down a DDS with an MDD and multiturn encoder. When the system is again powered up, the absolute position given by the encoder is compared with the value which is stored. This occurs during Communication Phase 4 Transition Check. If the deviation between values is larger than the value in the Absolute Encoder Monitoring Window, IDN P-0-0097, this error will occur. This error can be reset.

81 Program RAM is Defective

The memory components in the drive are tested upon drive initialization. If the test fails due to a faulty component, this error occurs.

Possible Causes:

1. Defective drive.

Possible Solutions:

1. Replace drive.

82 Data RAM is Defective

The memory components in the drive are tested upon drive initialization. If the test fails due to a faulty component, this error occurs.

Possible Causes:

1. Defective drive.

Possible Solutions:

1. Replace drive.

83 Error Reading Amplifier Data

During drive initialization, the operation data is pulled from an EEPROM and placed into the drives working memory. If the access to this EEPROM fails, this error occurs.

Possible Causes:

Defective drive.

Possible Solutions:

Replace drive.

84 Invalid Amplifier Data

Possible Causes:

1. Defective drive.

Possible Solutions:

1. Replace drive.

85 Error Writing Amplifier Data

An error occurred during the loading of data to the drives internal EEPROM.

Possible Causes:

1. Defective drive.

Possible Solutions:

1. Replace drive.

86 Cannot Write to Parameter Memory

Possible Causes:

1. Defective program module.

Possible Solutions:

1. Save the drive parameters, exchange the program module and load the parameters into the new module.

87 Data of the Parameter Memory is Invalid

During initialization of the drive it was found that one or more parameters in the software module are invalid.

Possible Causes:

1. The software module has not been previously initialized.
2. The EPROMs of the software module were changed, i.e. software update.
3. Defective software module.

Possible Solutions:

1. **SERCOS Interface:**
   Write valid data to invalid parameters.
2. **Analog Interface:**
   Start the user interface, (via the RS232), and look at every sub-menu under "Parameters". Invalid parameters are indicated by a value = ***. Enter the valid data where this value exists.
3. Exchange software module if necessary.

88 Error Reading Motor Data

All motor data is stored in the feedback of the motor. An error occurred while reading this data.

Possible Causes:

1. Motor feedback cable defective.
2. Motor feedback defective.

Possible Solutions:

1. Check and replace motor feedback cable if necessary.
2. Check and replace motor feedback if necessary.

89 Motor Data Invalid

Possible Causes:

1. Motor feedback defective.

Possible Solutions:

1. Exchange motor.

90 Error Writing Motor Data

An error exists writing data to the motor feedback.

Possible Causes:

1. Defective feedback cable.
2. Defective motor feedback.

Possible Solutions:

1. Check and replace feedback cable if necessary.
2. Check and replace motor if necessary.

91 Configuration Error

Possible Causes:

1. Hardware configuration is not compatible with software.
2. Plug in module is defective, not plugged in or plugged in incorrectly.

Possible Solutions:

1. Check configuration with DDS 2.1 Selection Guide.
2. Check and replace software and/or hardware if necessary.

92 Absolute Encoder not configured

The reference position parameter and/or the count direction in the menu "Absolute Encoder Parameters" of the RS232 interface in an analog DDS configuration cannot be read.

Possible Causes:

1. A value for this parameter was never entered.
2. DSF Feedback is defective

Possible Solutions:

1. Enter parameter or verify data.
2. Exchange motor.

6.2. SERCOS Communication Diagnostics

The following diagnostics are for SERCOS specifically and have 3 digit error codes which are 200 and 300 level codes. Since these codes have 3 digits they cannot be displayed on the 2 digit 7-segment display of the DDS 2.1, (H1 display). When a 3 digit error occurs, a blinking 32 diagnostic is seen on the H1 display, which signifies that IDN S-0-0095 must be read to see the actual diagnostic. In most cases, this is already done automatically by the control unit which will display the full diagnostic text on its screen or display.

6.2.1. SERCOS Interface Communication Error Messages

200 Parameter Loss

A check sum exists for every parameter and is stored in the program module. During drive initialization, as the parameters are read, the drive calculates and compares the checksums to those stored in the program modules. If these calculated checksums do not correspond with the stored values, this error condition occurs.

Possible Causes:

1. A hardware fault exists in the program module of the drive or in the drive itself.

Possible Solutions:

1. Save the drive parameters, exchange the program module and load the parameters into the new module.

201 Parameter Set Incomplete

The parameters stored in the program module are not all valid.

Possible Causes:

1. The inserted program module has not yet been completely programmed with parameter values.
2. The parameter sets have been entered completely, but there is still invalid data for one or more parameters. IDN's S-0-0021 and S-0-0022 contain a list of ID numbers of the operation data which was considered invalid by the drive during communication phases 2 and 3 respectively.

Possible Solutions:

1. Check the ID number lists for invalid data and make corrections as necessary.

202 RAM Error

The read/write memory in the drive is not functional.

Possible Causes:

1. Hardware fault in the drive.

Possible Solutions:

1. Check drive and replace if necessary.

208 Telegram Type Invalid

The telegram type entered in IDN S-0-0015 does not correspond with the SERCOS Interface specification.

Possible Causes:

1. The drive has attempted to implement an invalid telegram type.

Possible Solutions:

1. Check documentation for control unit or contact manufacturer.

209 t_1 too Small : $t_1 < t_{1min}$

The Master attempted to load a value for S-0-0006, AT Transmission Starting Time, t_1, which was smaller than t_{1min}, IDN S-0-0003.

Possible Solutions:

1. The Master control must load all timing parameters in accordance with the SERCOS Interface specification. Check documentation for control unit or contact manufacturer.

210 t_2 too Large : $t_2 + t_{MTSG} > t_{SCYC}$

The Master attempted to load a value for S-0-0089, MDT Transmit Starting Time, t_2, which was too large.

Possible Solutions:

1. The Master control must load all timing parameters in accordance with the SERCOS Interface specification. Check documentation for control unit or contact manufacturer.

211 Master Data Telegram too Long

The Master attempted to load a value for S-0-0010, Length of MDT, which was too large.

Possible Solutions:

1. The Master control must load all timing parameters in accordance with the SERCOS Interface specification. Check documentation for control unit or contact manufacturer.

212 t_1 too Large : $t_1 + t_{ATMT} + AT > t_2$

The Master attempted to load a value for S-0-0006, AT Transmission Starting Time, t_1, which was too large.

Possible Solutions:

1. The Master control must load all timing parameters in accordance with the SERCOS Interface specification. Check documentation for control unit or contact manufacturer.

213 t_4 too Large : $t_4 + t_5 > t_{Scyc}$

The Master attempted to load a value for S-0-0007, Feedback Acquisition Starting Time, t_4, which was too large.

Possible Solutions:

1. The Master control must load all timing parameters in accordance with the SERCOS Interface specification. Check documentation for control unit or contact manufacturer.

214 t_3 too Large : $t_3 > t_{Scyc}$

The Master attempted to load a value for S-0-0008, Command Valid Time, t_3, which was too large.

Possible Solutions:

1. The Master control must load all timing parameters in accordance with the SERCOS Interface specification. Check documentation for control unit or contact manufacturer.

215 Beginning Address in the MDT is too Large

The Master attempted to load a value for S-0-0009, Beginning Address in MDT, which was too large.

Possible Solutions:

1. The Master control must load certain initialization parameters in accordance with the SERCOS Interface specification. Check documentation for control unit or contact manufacturer.

216 SERCOS Cycle Time Error

An invalid value exists for the SERCOS Cycle Time, (t_{Scyc}), IDN S-0-0002.

Possible Solutions:

1. The cycle times for the DDS 2.1 are limited to integer multiples of 1msec. Enter an acceptable value which is allowed by the control unit and which is in accordance with the DDS 2.1 limitations.

217 Telegram Type is Not Supported

The telegram type which was selected in IDN S-0-0015 is not supported by the DDS 2.1.

219 Beginning Address Fault in MDT

The data contained in the parameter "Length of the MDT", IDN S-0-0009, is invalid.

Possible Solutions:

1. Contact control unit manufacturer

243 Error During Position Initialization

The position of the motor encoder is calculated during the initialization process of the drive. If an error occurs during this calculation, this error message is produced.

Possible Solutions:

1. Check the motor feedback cable and replace if necessary. If the motor feedback cable is OK, check the motor feedback and replace if necessary.

250 No Absolute Encoder Present

When trying to execute the procedure command "Set Absolute Measuring", IDN P-0-0012, the drive did not find an absolute encoder on the motor.

Possible Solutions:

1. Exchange the motor with one that has an absolute feedback mounted.

260 Drive Into Positive Stop Procedure Command Error

An error occurred during the execution of the procedure command "Drive Into Positive Stop", IDN S-0-0149. This will cause the drive to shut itself down.

270 Homing Error

For a motor with an absolute feedback, the command "Drive Controlled Homing Procedure" is not necessary. The drive may also not have its reference distance set.

Possible Solutions:

1. Manually jog the axis to a known reference position. Enter the desired position value in the parameter "Position Feedback 1 - Reference Distance", IDN S-0-0052.

271 Drive not Homed

The axis has not been homed after powering up the system, or in the case of an absolute feedback, the initial homing has not taken place yet, (on the first startup).

Possible Solutions:

1. Manually jog the axis to a known reference position. Enter the desired position value in the parameter "Position Feedback 1 - Reference Distance", IDN S-0-0052.

6.2.2. SERCOS Interface Status Messages

300 **Drive in Torque Loop Regulation**

301 **Drive in Velocity Loop Regulation**

302 **Position Loop Regulation with Feedback 1 (Motor Encoder)**

303 **Position Loop Regulation with Feedback 1 (Motor Encoder), without Lag**

304 **Position Loop Regulation with Feedback 2 (External Encoder)**

305 **Position Loop Regulation with Feedback 2 (External Encoder), without Lag**

320 **Communication Phase 3 Transition Check**

321 **Communication Phase 4 Transition Check**

322 **Procedure Command "Set Absolute Measuring", IDN P-0-0012, is Active**

323 **Procedure Command "Drive into Positive Stop", IDN S-0-0149, is Active**

330 **Procedure Command "Drive Controlled Homing", IDN S-0-0148, is Active**

6.3. Status Display during Drive Initialization with the SERCOS Interface

When the DDS 2.1 drive is first started up, it goes through an initialization process which sets parameters and the memory for normal operation. The following diagnostics describe the process steps as they occur.

-0	SERCOS Interrupt reset
-1	Reset data RAM
-2	Drive checks the DSM parameter memory and resets if necessary (For new DSM Modules, this status is displayed for about 15 sec)
-3	Load Program (EPROM to RAM)
-4	Hardware Check (Data RAM)
-5	Hardware Initialization
-6	Software Initialization (EEPROM Data to RAM; Input Limits)
-7	Software Initialization (Oscilloscope Function, Feedback Code
-8	Software Initialization (DSF Motor Data Read
-9	SERCOS Initialization

6.4. DSS 1.1 SERCOS Interface Module Diagnostic Codes

The DSS 1.1 SERCOS Interface Module, which is plugged into the first card slot of the DDS 2.1, (slot U1), has a 1 digit 7-segment diagnostic display. This display gives additional information regarding the SERCOS communication status.

6

Initialization Not Yet Started

The drive is in Communication Phase 0, yet it has not received any MST's

Possible Solution:

Make sure the fiber optic ring is closed with all fiber optic connections.

0

Communication Phase 0

The switching from Communication Phase 0 to 1 has not yet been initiated by the master.

Possible Solution:

See Control Unit users manual or contact manufacturer.

1

Communication Phase 1

The switching from Communication Phase 1 to 2 has not yet been initiated by the master.

Possible Solution:

See Control Unit users manual or contact manufacturer.

2

Communication Phase 2

Before the control unit switches to Communication Phase 3, it checks that all the timing parameters are correct to insure that the system may operate correctly with the full timing structure in place. This diagnostic informs the user that Phase 2 Parameterization is not yet complete or correct.

Possible Solution:

Check the List of Invalid ID Numbers for Communication Phase 2, IDN S-0-0021, for all invalid ID numbers.

3

Communication Phase 3

Before the control unit switches to Communication Phase 4, it checks that all the application parameters are correct to insure that the system may operate correctly in its normal operation modes. This diagnostic informs the user that Phase 3 Parameterization is not yet complete or correct.

Possible Solution:

Check the List of Invalid ID Numbers for Communication Phase 3,
IDN S-0-0022, for all invalid ID numbers.

4

Communication Phase 4

Drive is in normal operation.

5

Hardware Error

Possible Solutions:

1. Exchange SERCOS Interface Module
2. Exchange DDS 2.1 drive

MST Failure

The Master Synchronization Telegram was missing in two consecutive SERCOS cycles. This is monitored during Communication Phases 3 and 4.

Possible Causes:

1. Optical losses in the cable are too high. (Cable possibly too long).
2. Fault occurred in the control unit.
3. Noise in the fiber optics.
4. Noise within the SERCOS Interface.

Possible Solutions:

1. Check the status of the control unit.
2. Examine all fiber optic connections. (Make sure the ends of the cables are not contaminated).
3. Measure the losses of the fiber optic cables. Check the length of the fiber optic cables.
4. Exchange SERCOS Interface boards.

MDT Failure

The Master Data Telegram was missing in two consecutive SERCOS cycles. This is monitored during Communication Phases 3 and 4.

Possible Causes:

1. Optical losses in the cable are too high. (Cable possibly too long).
2. Fault occurred in the control unit.
3. Noise in the fiber optics.
4. Noise within the SERCOS Interface.

Possible Solutions:

1. Check the status of the control unit.
2. Examine all fiber optic connections. (Make sure the ends of the cables are not contaminated).
3. Measure the losses of the fiber optic cables. Check the length of the fiber optic cables.
4. Exchange SERCOS Interface boards.

8 or 9 SERCOS Interface Module in Test Mode

The SERCOS Interface Module has been switched to test mode.

Possible Solutions:

1. Contact Indramat Service.

11 Invalid Communication Phase

SERCOS Master is attempting to run in a non-permissible communication phase, (Phase > 4).

Possible Causes:

1. Error in SERCOS Master module in control unit.

Possible Solutions:

1. Check documentation for control unit or contact manufacturer.

Error Advancing Communication Phases

The prescribed sequence has not been followed in the advancing of the communication phases.

Possible Causes:

1. Error in SERCOS Master module in control unit.

Possible Solutions:

1. Check documentation for control unit or contact manufacturer.

Error Descending Communication Phases

The prescribed sequence has not been followed in the descent of the communication phases.

Possible Causes:

1. Error in SERCOS Master module in control unit.

Possible Solutions:

1. Check documentation for control unit or contact manufacturer.

6.5. RS232 User Interface Diagnostics for the DDS 2.1 with Analog Interface

This is a summary of the diagnostics which appear on the VT-100 terminal when communication to an analog drive via the RS-232 interface.

Parameter is outside of the input limits

Input limits may be displayed by pressing F1 on the PC or terminal.

Cannot write to parameter memory

An error occurred when trying to write to a parameter in the DSM 2.1 Module.

Possible Solutions:

1. Try writing to the parameter again. If the error message appears again, replace the DSM Module.

Cannot write to parameter with RF "ON"

Turn RF off before changing the parameter

Commutation Adjustment not possible with RF "ON"

Turn RF off and try commutation adjustment again

Commutation Adjustment not possible: Power is "OFF"

Turn main power on and try commutation adjustment again.

6.6. Status During Drive Initialization with an Analog Interface

-1	Data RAM Test
-2	Waiting for PLL Lock
-3	Hardware Initialization
-4	Read Parameters from DSM Module
-5	Read Amplifier Parameters
-6	Read Motor Data Parameters from DSF
-7	Configuring RS232 User Interface - Language Selection
-8	Calculate Run Time Parameters
-9	Position Initialization

bb	Operation Ready
Ab	Drive Ready
AF	Drive Enabled
AH	Drive Halt
AS	Safety Interlock
P0	Communication Phase 0
P1	Communication Phase 1
P2	Communication Phase 2
P3	Communication Phase 3
P4	Communication Phase 4
01	MST Failure
02	MDT Failure
03	Invalid Communication Phase
04	Error Advancing Communication Phases
05	Error Descending Communication Phases
06	Comm. Phase Switched without Ready Message
07	Switched to a Non-Initialized Operation Mode
18	Amplifier Over Temperature Shutdown
19	Motor Over Temperature Shutdown
21	Control Voltage Error
22	Motor Encoder Error
24	Over Current
25	Over Voltage
26	Under Voltage
28	Excessive Deviation
30	Overtravel Limit Exceeded, Shutdown
32	Procedure Command Execution Error
33	External Power Supply Error
34	Internal Software Synchronization Error
35	Home Switch Position Error
37	Excessive Position Command Value Difference
38	Absolute Encoder Power Interrupted
39	Absolute Encoder Reference Lost
41	Absolute Encoder Interface Defective
42	Ext. Encoder Error : Signal Amplitude too Small
43	Invalid Feedback Data - Communication Phase 2
44	Overtravel Limit Switch Activated
45	External Encoder Error : Quadrant Error
46	Ext. Encoder Error : Max. Frequency Exceeded
47	Error Capturing Marker Pulse of Ext. Encoder
48	Absolute Encoder Battery Under Voltage
50	Amplifier Over Temperature Warning
51	Motor Over Temperature Warning
60	Bridge Fuse
61	Earth Ground Connection
67	Hardware Synchronization Fault
68	Brake Fault
69	±15 Volt Error
70	+24 Volt Error
71	+10 Volt Error
72	+8 Volt Error
73	Driver Stage Power Supply Fault
76	Absolute Encoder Error
81	Program RAM is Defective
82	Data RAM is Defective
83	Error Reading Amplifier Data
84	Invalid Amplifier Data
85	Error Writing Amplifier Data
86	Parameter Memory is not Writable
87	Data of the Parameter Memory is Invalid
88	Error Reading Motor Data
89	Motor Data Invalid
90	Error Writing Motor Data
91	Configuration Error

Status During Initialization with SERCOS Interface

-0	SERCOS Interrupt reset
-1	Reset data RAM
-2	DSM parameter memory check
-3	Load Program (EPROM to RAM)
-4	Hardware Check (Data RAM)
-5	Hardware Initialization
-6 -7 -8	Software Initialization
-9	SERCOS Initialization

Status During Initialization with Analog Interface

-1	Data RAM Test
-2	Waiting for PLL Lock
-3	Hardware Initialization
-4	Read Parameters from DSM Module
-5	Read Amplifier Parameters
-6	Read Motor Data Parameters from DSF
-7	Configuring RS232 User Interface
-8	Calculate Run Time Parameters
-9	Position Initialization

DSS Card Diagnostics (H2 Display)

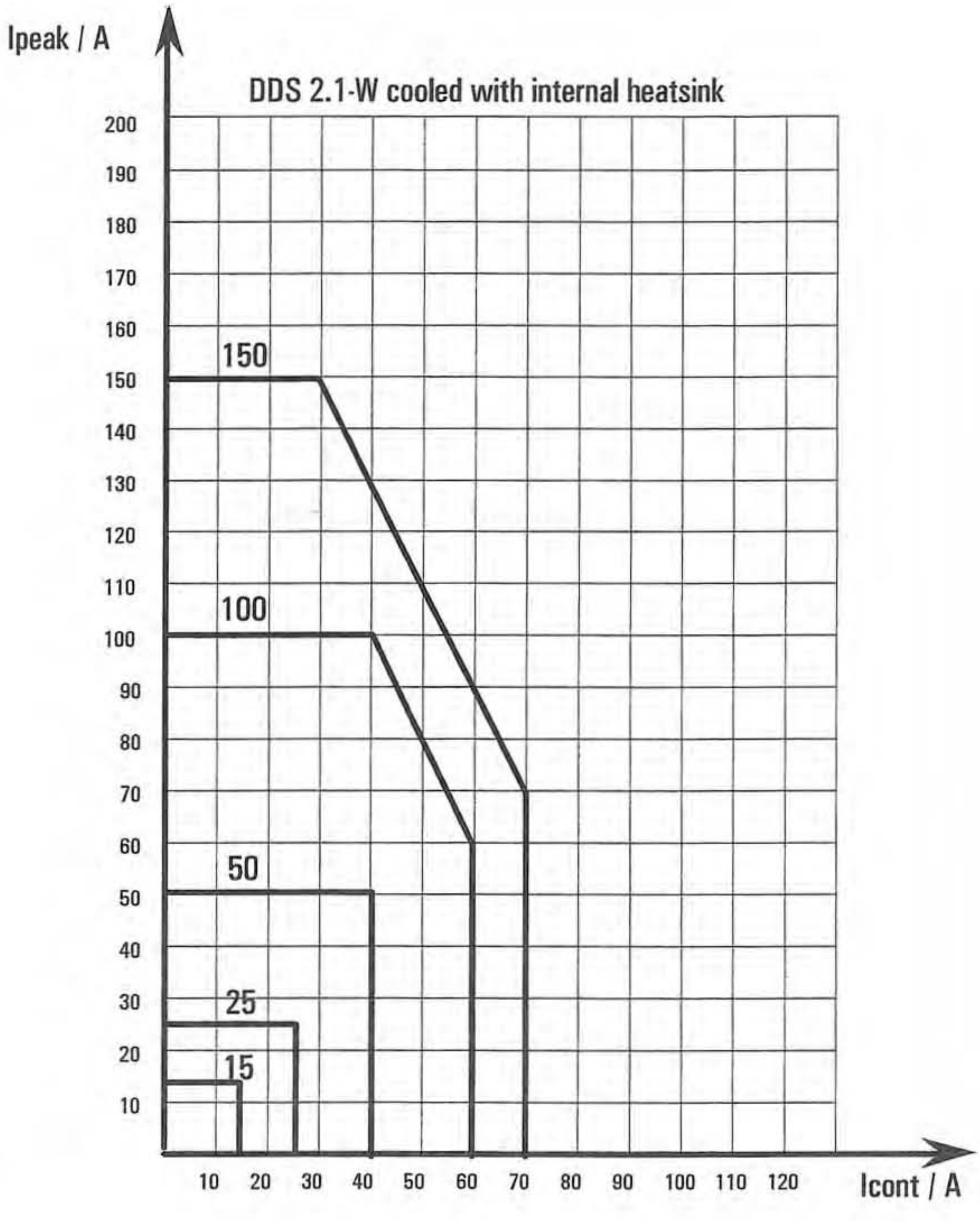
6	Initialization not yet started
0	Communication Phase 0
1	Communication Phase 1
2	Communication Phase 2
3	Communication Phase 3
4	Communication Phase 4
5	Hardware Error
0	MST Failure (After Phase 3)
b	MDT Failure (After Phase 3)
8 or 9	SERCOS Interface Module in Test Mode
11	Invalid Communication Phase
1'	Error Advancing Communication Phases
1.	Error Descending Communication Phases

APPENDIX A: TECHNICAL SPECIFICATIONS

CAUTION: Drawings in this Appendix are included for illustrative purposes only and are subject to change without notice. Check with Indramat to be sure you are working with the latest drawings prior to installing, wiring and powering equipment.

DDS 2.1-W...- Technical Data Sheet

Description	Symbol	Units	DDS 2.1-W015-D	DDS 2.1-W025-D	DDS 2.1-W050-D	DDS 2.1-W100-D	DDS 2.1-W150-D
Cooling Method			Fluid Cooled				
DC Bus Voltage	V (DC)	V	320 V ± 15%				
Rated Current	I (rated)	A	15	25	50	100	150
Peak Current	I (peak)	A	15	25	50	100	150
Continuous Current	I (cont)	A	15	25	40	60	70
Rated Power	P (rated)	KVA	4.5	7.5	15	30	45
Internal power dissipation at I_{cont}	P(int)	W	110	170	260	380	440
External power dissipation at I_{cont}	P(ext)	W	--	--	--	--	--
Low voltage current consumption + 24 V Regulated + 15 V - 15 V	I (+UL) I (+UM) I (-UM)	mA mA mA	500 Basic Equipment 150 150				
Ventilation Fan Supply Voltage	V	V	Internal 24V (connected internally)				
Weight	m	kg	≈ 7.5				
Allowable ambient temperature range for nominal operating data		°C	+5 to +45				
Maximum ambient temperature for reduced operating data		°C	+55				
Storage and transport temperature		°C	-30 to 85				
Altitude rating without reduction of operating data			Max. 1000 meters above sea level				
Allowable Humidity per DIN Humidity Classes			Class F according to DIN 40 040				
Isolation Class			Class C according to DIN 57 0110				
Protection Rating			IP 10 from DIN 40 050				


Ipeak / A
DDS 2.1-W cooled with internal heatsink
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10 20 30 40 50 60 70 80 90 100 110 120
Icont / A

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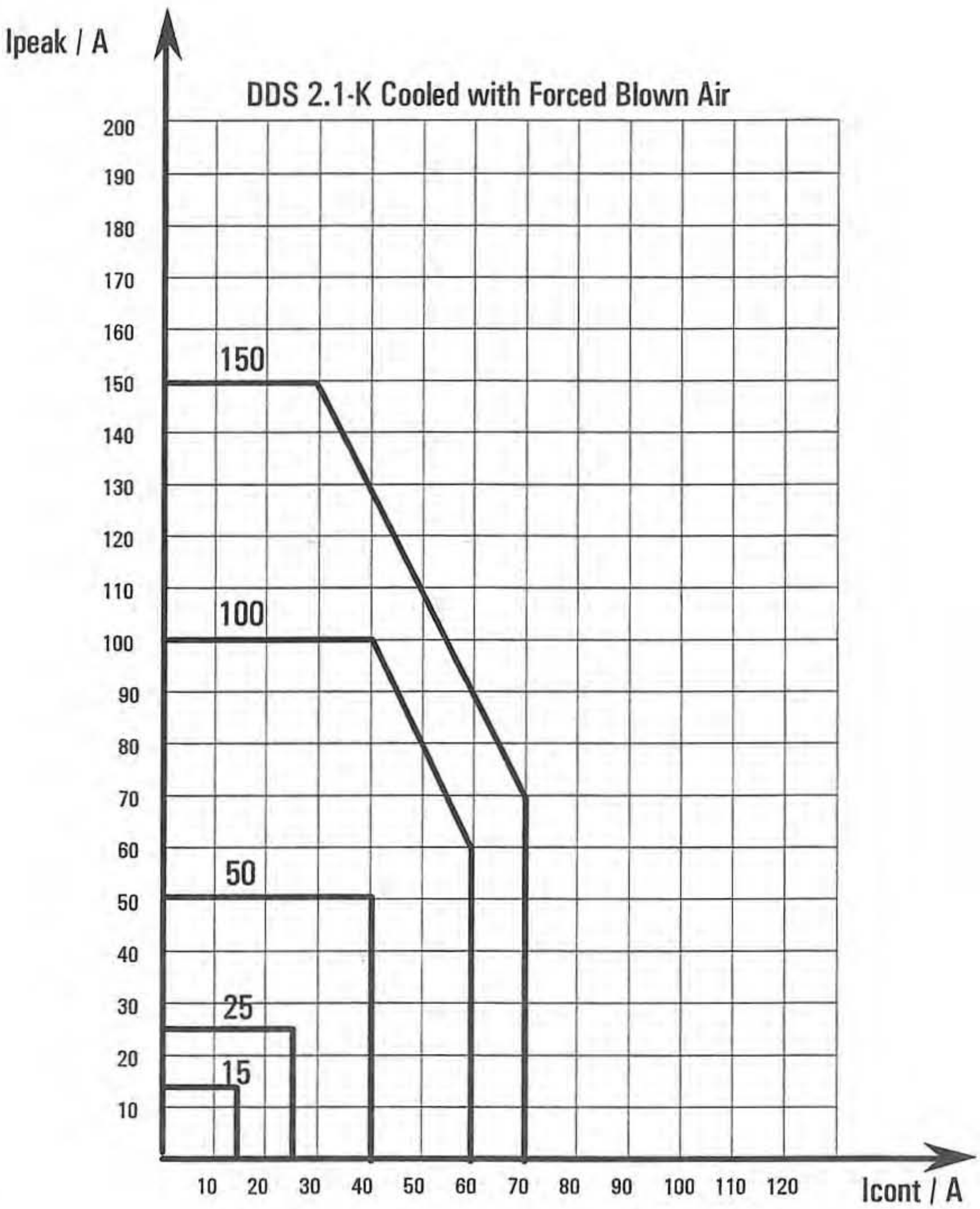
DDS 2.1-K ...- Technical Data Sheet

Description	Symbol	Units	DDS 2.1-K015-D	DDS 2.1-K025-D	DDS 2.1-K050-D	DDS 2.1-K100-D	DDS 2.1-K150-D
Cooling Method			Fluid Cooled				
DC Bus Voltage	V (DC)	V	320 V ± 15%				
Rated Current	I (rated)	A	15	25	50	100	150
Peak Current	I (peak)	A	15	25	50	100	150
Continuous Current	I (cont)	A	15	25	40	60	70
Rated Power	P (rated)	KVA	4.5	7.5	15	30	45
Internal power dissipation at I_{cont}	P(int)	W	38	50	68	92	104
External power dissipation at I_{cont}	P(ext)	W	72	120	192	288	336
Low voltage current consumption + 24 V Regulated + 15 V - 15 V	 I (+UL) I (+UM) I (-UM)	 mA mA mA	 500 Basic Equipment 150 150				
Ventilation Fan Supply Voltage	V	V	Internal 24V (connected internally)				
Weight	m	kg	≈ 7.5				
Allowable ambient temperature range for nominal operating data		°C	+5 to +45				
Maximum ambient temperature for reduced operating data		°C	+55				
Storage and transport temperature		°C	-30 to 85				
Altitude rating without reduction of operating data			Max. 1000 meters above sea level				
Allowable Humidity per DIN Humidity Classes			Class F according to DIN 40 040				
Isolation Class			Class C according to DIN 57 0110				
Protection Rating			IP 10 from DIN 40 050				


Ipeak / A
DDS 2.1-K Cooled with Forced Blown Air
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10 20 30 40 50 60 70 80 90 100 110 120
Icont / A

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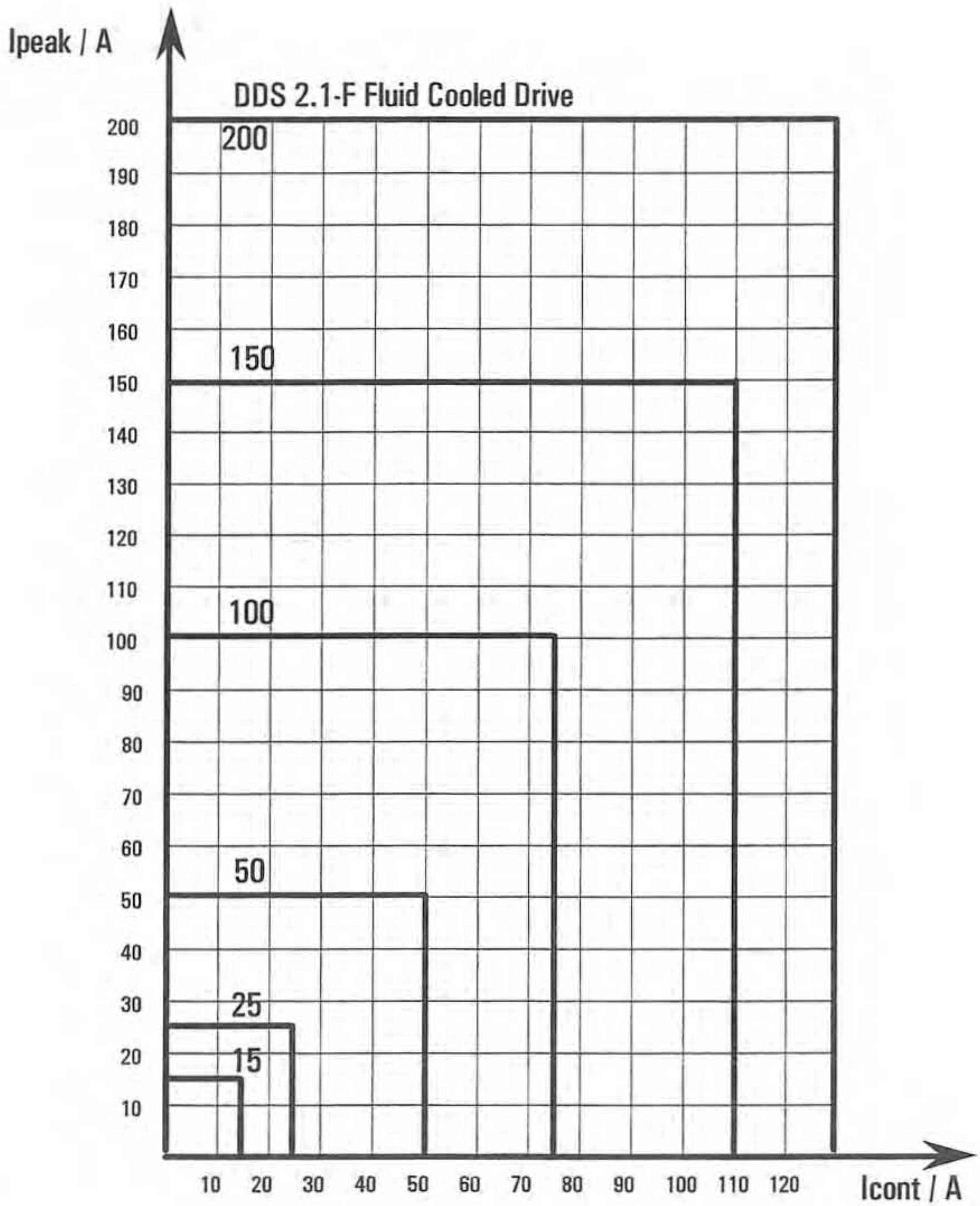
DDS 2.1-F ...- Technical Data Sheet

Description	Symbol	Units	DDS 2.1-F015-D	DDS 2.1-F025-D	DDS 2.1-F050-D	DDS 2.1-F100-D	DDS 2.1-F150-D	DDS 2.1-F200-D
Cooling Method			Fluid Cooled					
DC Bus Voltage	V (DC)	V	320 V ± 15%					
Rated Current	I (rated)	A	15	25	50	100	150	200
Peak Current	I (peak)	A	15	25	50	100	150	200
Continuous Current	I (cont)	A	15	25	50	75	100	120
Rated Power	P (rated)	KVA	4.5	7.5	15	30	45	60
Internal power dissipation at I_{cont}	P(int)	W	25	28	36	44	52	58
External power dissipation at I_{cont}	P(ext)	W	90	150	300	450	600	718
Low voltage current consumption + 24 V Regulated + 15 V - 15 V	I (+UL) I (+UM) I (-UM)	mA mA mA	500 Basic Equipment 150 150					
Ventilation Fan Supply Voltage	V	V	....					
Weight	m	kg	≈ 8					
Allowable ambient temperature range for nominal operating data		°C	+5 to +45					
Maximum ambient temperature for reduced operating data		°C	+55					
Storage and transport temperature		°C	-30 to 85					
Altitude rating without reduction of operating data			Max. 1000 meters above sea level					
Allowable Humidity per DIN Humidity Classes			Class F according to DIN 40 040					
Isolation Class			Class C according to DIN 57 0110					
Protection Rating			IP 10 from DIN 40 050					


Ipeak / A
DDS 2.1-F Fluid Cooled Drive
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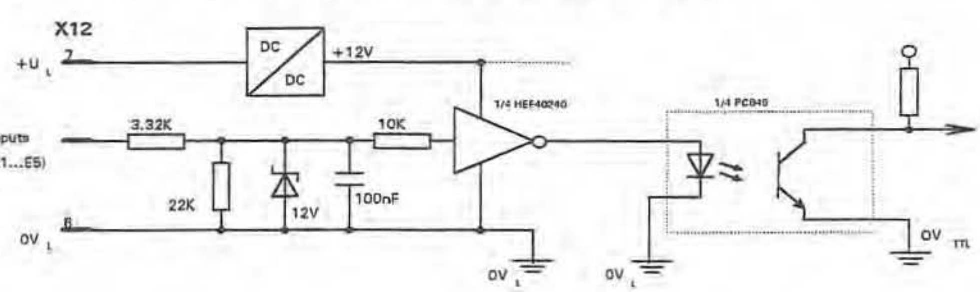
10 20 30 40 50 60 70 80 90 100 110 120
Icont / A

DSS 1.1 SERCOS Interface for DDS 2.1 - Technical Specifications

	Description		Units	Min.	Typ.	Max.
Inputs	External Supply Voltage U_L		V	18	24	32
	External Supply Current Consumption, I_L		mA			100
	Inputs	V_{HIGH}	V	12	24	32
	E1...E5	V_{LOW}	V	0	0	3
Transmission Data T_X	S1.1 Switch Setting			"HIGH" = OFF		"HIGH" = ON
	Max. transmission power at a low optical level:	P_{SmaxL}	dBM/ (µW)	-31.2/ (0.75)		-28.2/ (1.5)
	Min. transmission power at a high optical level:	P_{SminH}	dBM/ (µW)	-10.5/ (90)		-7.5/ (180)
	Max. transmission power at a high optical level:	P_{SmaxH}	dBM/ (µW)	-5.5/ (280)		-3.5/ (450)
	Wavelength of the transmission diode : Peak Wavelength - λp Spectral Bandwidth - Δλ		nm	640 - 675 nm (0°C - 55°C) ≤ 30 nm (25°C)		
Receiver Data R_X	Max. Receiver power at a low optical level:	P_{RmaxL}	dBM/ (µW)	-31.2/ (0.75)		
	Min. receiver power at a high optical level:	P_{RminH}	dBM/ (µW)	-20/ (10)		
	Max. receiver power at a high optical level:	P_{RmaxH}	dBM/ (µW)	-5/ (320)		
	System Value* $P_{SminH} - P_{RmaxH}$		dB	9.5		12.5
General	Ambient Temperature		°C	+5°C to +45°C - Operating Temp -30°C to +85°C - Stor./Trnsprt Temp		
	Allowable humidity as per DIN Humidity Class		%	75% Average, 85% Occasionally DIN 40 040 Class F		
	Weight		g	150		

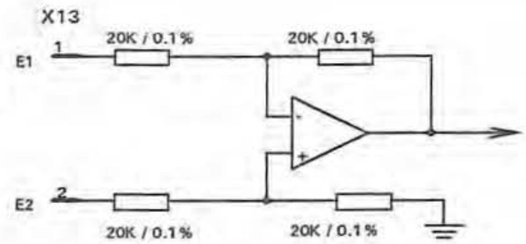
* System Value = Maximum allowable attenuation of the transmission line



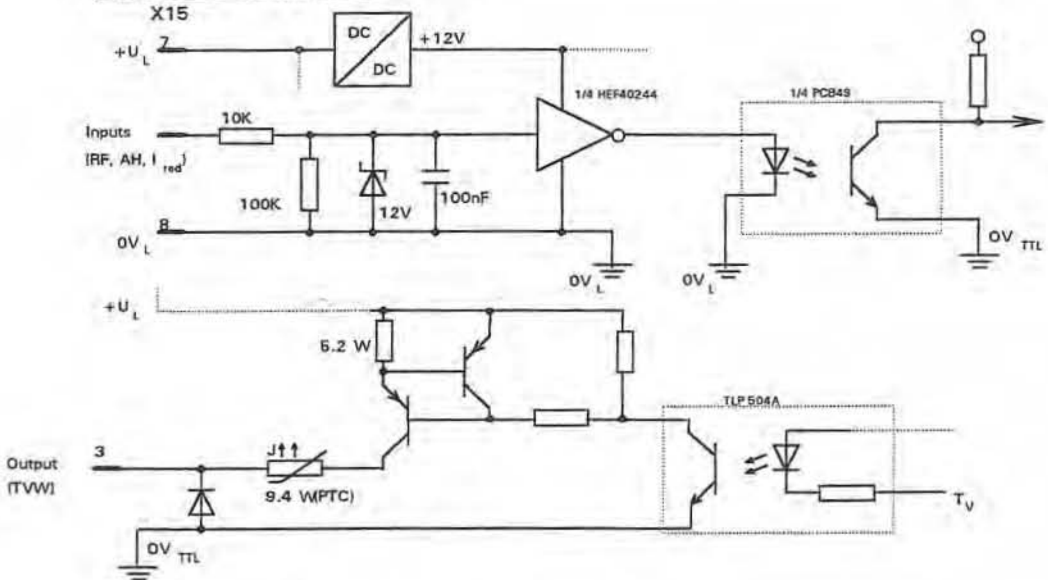
DAE 1.1 Analog Interface for DDS 2.1 - Technical Specifications

	Description		Units	Min.	Typ.	Max.
Analog Interface	Input Voltage	$E1_{posin}$	V	-10		+10
		$E2_{negin}$	V	-10		+10
		ΔV	V			10
	Input Current	$E1_{posin}$	mA	-0.25		+0.25
		$E2_{negin}$	mA	-0.5		+0.5
Inputs and Outputs	External Supply Voltage U_L		V	18	24	32
	External Supply Current Consumption, I_L		mA			100
	Inputs	V_{HIGH}	V	+12		+32
	RF, AH, I_{red}	V_{LOW}	V	0		+3
	Output TVW	I_{OUT}	mA			100
Incremental Encoder Interface	Supply Voltage $+5V_{ext}$		V	4.75	5.0	5.25
	Current Consumption I_{ext}		mA			200
	Signal Level	V_{HIGH}	V	1.8	3.3	5.25
	at 40 mA	V_{LOW}	V		0.22	0.5
	Output Current		mA			40
	Output Frequency		KHz			504
	Rise and Fall Times		nsec			100
	Marker Pulse Lag , t_1		nsec	0	15	30
	Time Between Edges, t_2		nsec	1		
				Digital Servo Feedback		Resolver Feedback
	Resolution*		cyc./rev	1 ... 16383		1 ... 16383
	Marker Pulse		Number / Motor Rev	1 (1 every 360°)		2 (1 every 180°)
	Marker Pulse Offset*		Angular degrees of the motor	0 ... 360°		0 ... 180°
General	Ambient Temperature		°C	+5°C to +45°C - Operating Temp -30°C to +85°C - Stor./Trnsprt Temp		
	Allowable humidity as per DIN Humidity Class		%	75% Average, 85% Occasionally DIN 40 040 Class F		
	Weight		g	150		

Basic Representaion of the Analog Input Circuits

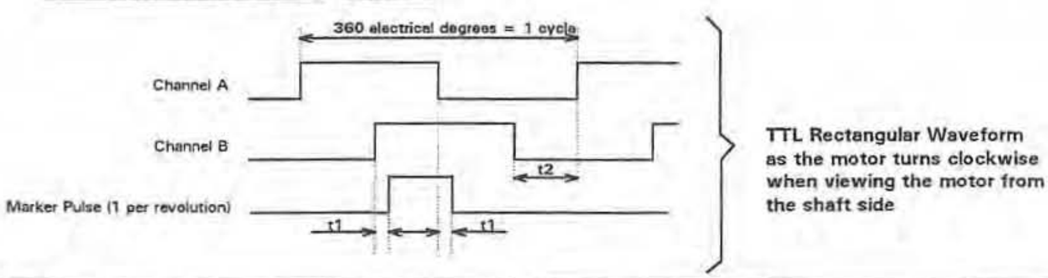


Basic Representaion of the Digital Input and Output Circuits



Basic Representaion of the Incremental Encoder Output Circuits

Incremental Encoder Output Signals

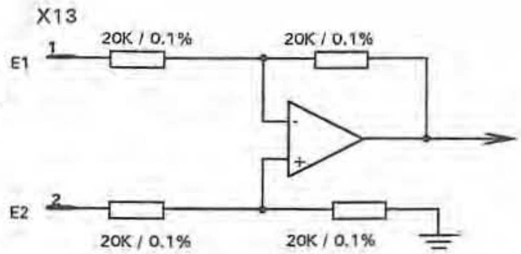


DAA 1.1 Analog Interface for DDS 2.1 - Technical Specifications

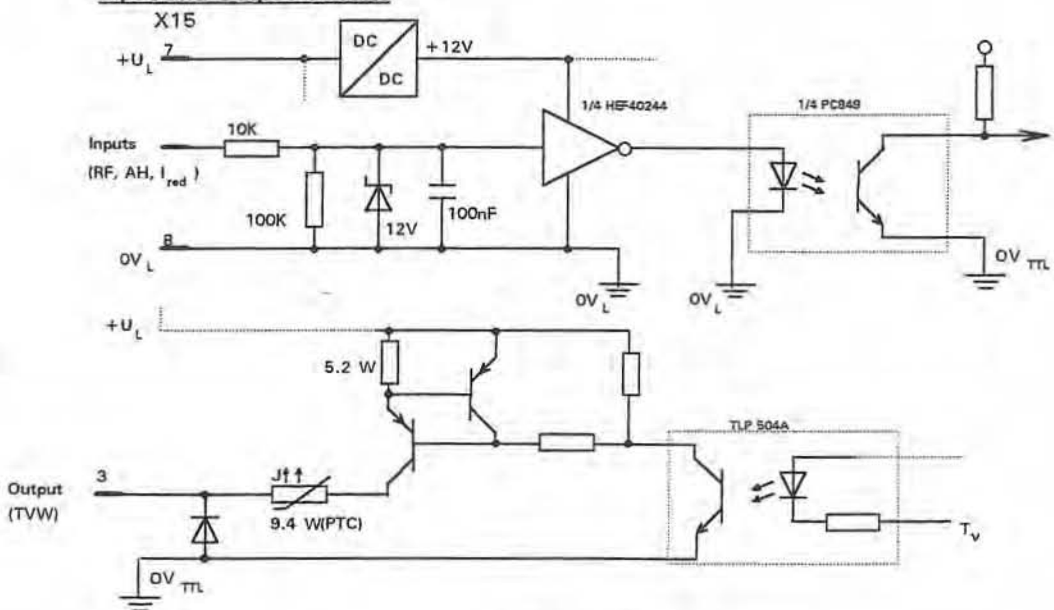
	Description		Units	Min.	Typ.	Max.
Analog Interface	Input Voltage	E1	V	-10		+10
		E2	V	-10		+10
		ΔV	V			10
	Input Current	E1	mA	-0.25		+0.25
		E2	mA	-0.5		+0.5
Inputs and Outputs	External Supply Voltage U_L		V	18	24	32
	External Supply Current Consumption, I_L		mA			100
	Inputs	V_{HIGH}	V	+12		+32
	RF, AH, I_{red}	V_{LOW}	V	0		+3
	Output TVW	I_{OUT}	mA			100
Absolute Encoder Interface	Supply Voltage $+V_{ext}$		V	10	24	32
	Current Consumption I_{ext}		mA			200
	Low Level Output Current I_{OL}		mA			60
	High Level Output Current I_{OH}		mA			-60
	Output Voltage V_O for $I_O = 0$		V	0		5.25
	Diff. Output Voltage $\|V_{DO1}\|$ for $I_O = 0$		V	1.5		5.25
	Diff. Output Voltage $\|V_{DO2}\|$ for $R_L = 54\Omega$		V	1.5	2.5	5.0
	Diff. Input High Voltage V_{TH}		V			0.2
	Diff. Input Low Voltage V_{TL}		V	-0.2		
	Hysteresis V_{HVS}		mV		50	
General	Ambient Temperature		°C	+5°C to +45°C - Operating Temp -30°C to +85°C - Stor./Trnsprt Temp		
	Allowable humidity as per DIN Humidity Class		%	75% Average, 85% Occasionally DIN 40 040 Class F		
	Weight		g	150		

A

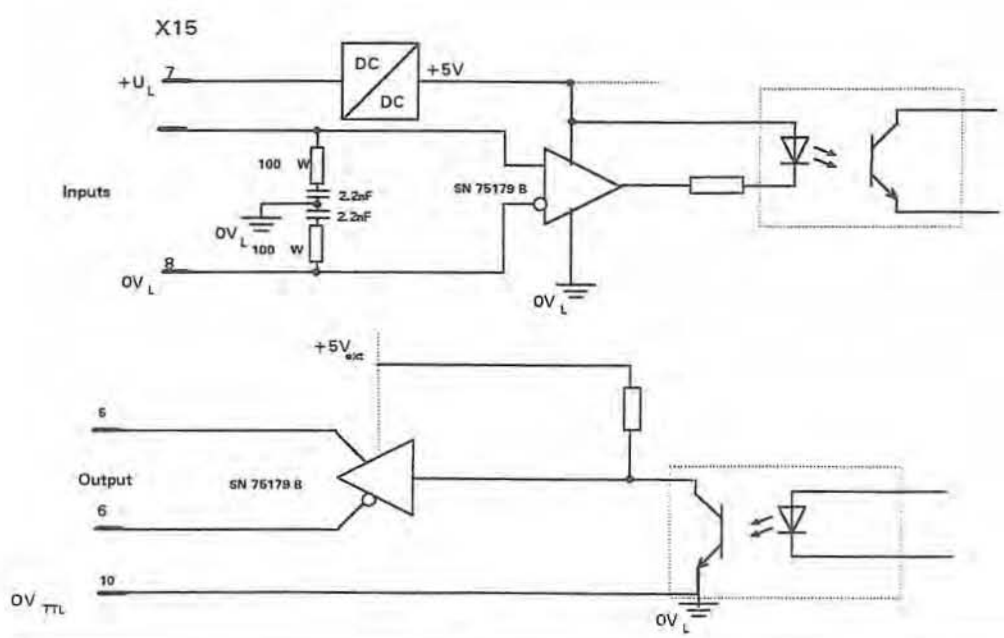
Basic Representaion of the Analog Input Circuits



Basic Representaion of the Digital Input and Output Circuits



Basic Representaion of the Absolute Encoder Input and Output Circuits



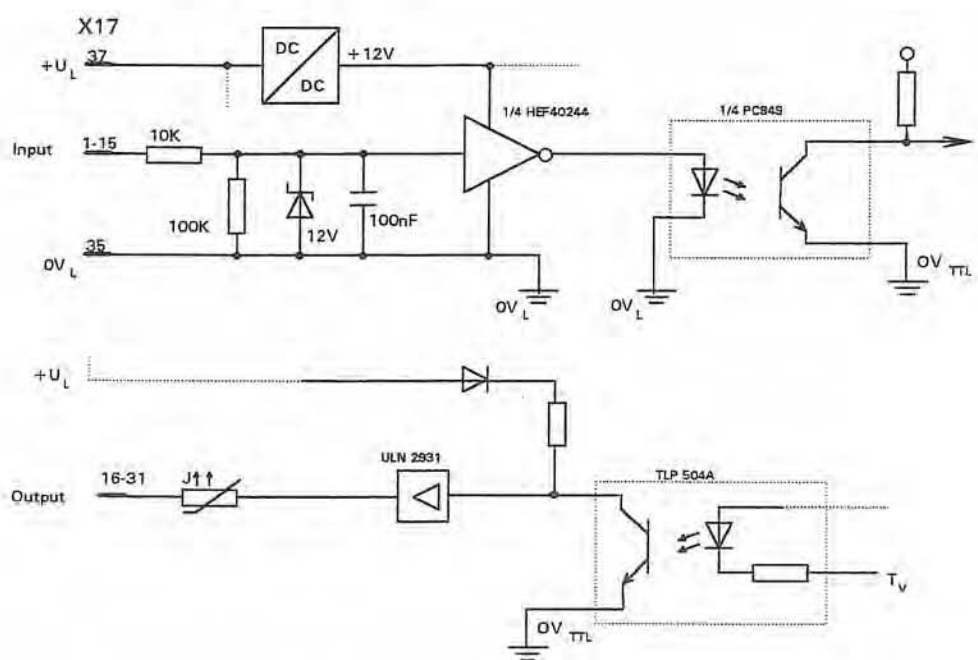
DEA 4.1 I/O Module for DDS 2.1 - Technical Specifications

Description		Units	Min.	Typ.	Max.
Power Supply Voltage	V_{ext}	V	+18	+24	+32
Current Consumption	I_{out}	A	0.15	0.2[1)]	2.2[2)]
Inputs	V_{high}	V	+12	+24	+32
X17, pins 1-15	V_{low}	V	0	< 1	+3
	V_{high}	V	+10	+18	+32
Outputs	V_{low}	V	0	0.8	1
X17, pins 16-31	I_L	mA	0	-	100

1) Current consumption of 0.2A assumes no loading at the 24V outputs.
2) Current consumption of 2.2A assumes all 24V outputs to be loaded at 100mA.
3) Activation of the output voltage depends upon the external supply voltage, V_{ext}, and the current loading, I_L.

$$V_{High} = +V_{ext'} - 1.4V - I_L * 55\Omega$$

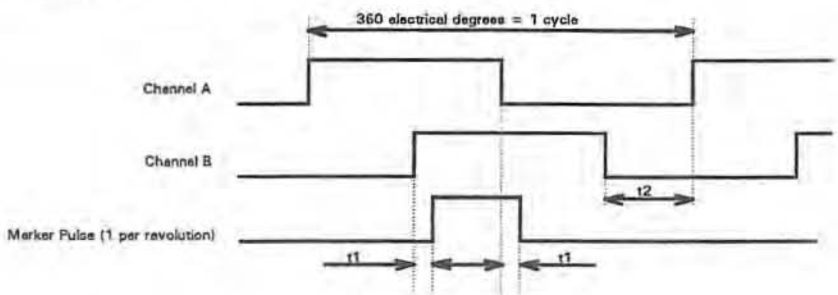
Basic Representaion of the Digital Input and Output Circuits



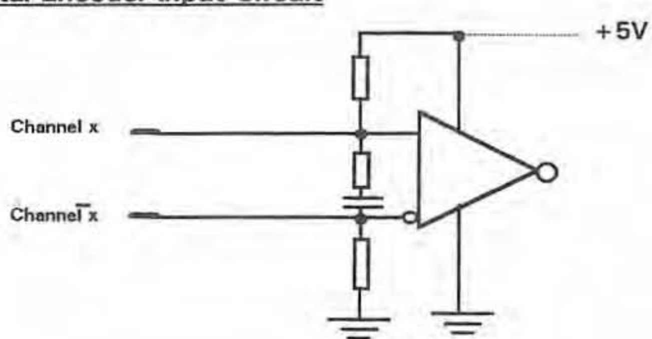
DEF 1.1 Incremental Encoder Input Card for DDS 2.1 - Technical Specifications

	Description		Units	Min.	Typ.	Max.
Encoder Supply Voltage	Output Voltage		V	4.75	5.0	5.25
	Output Current		mA			250
Incremental Encoder Input Signals	Signal Voltage	V_{HIGH}	V	2.5		
	Chan A, $\overline{A}$, B,$\overline{B}$, 0,$\overline{0}$	V_{LOW}	V			0.5
	Phase positions	A	°elec.		0	
		B	°elec.		90	
	Signal Waveform			Rectangular Waveform		
	Maximum Input Frequency		kHz			1000
	Interpolation of the Signal Period			4 times		
	Marker Pulse Delay, t1		nsec			50
	Time between edges, t2		nsec	250		
General	Ambient Temperature		°C	+5°C to +45°C - Operating Temp -30°C to +85°C - Stor./Trnsprt Temp		
	Allowable humidity as per DIN Humidity Class		%	75% Average, 85% Occasionally DIN 40 040 Class F		
	Weight		g	100		

Incremental Encoder Output Signals



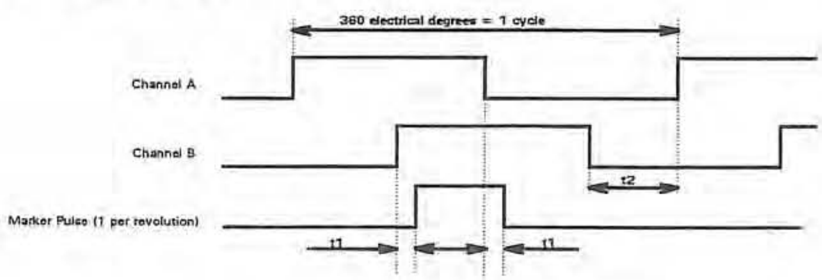
Incremental Encoder Input Circuit



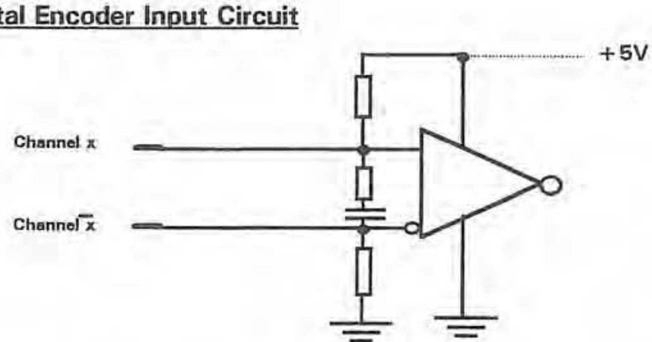
DEF 2.1 Incremental Encoder Input Card for DDS 2.1 - Technical Specifications

	Description		Units	Min.	Typ.	Max.
Encoder Supply Voltage	Output Voltage		V	4.75	5.0	5.25
	Output Current		mA			250
Incremental Encoder Input Signals	Signal Voltage	V_{HIGH}	V	2.5		
	Chan A, $\overline{A}$, B, $\overline{B}$, 0, $\overline{0}$	V_{LOW}	V			0.5
	Phase positions	A	°elec.		0	
		B	°elec.		90	
	Signal Waveform			Rectangular Waveform		
	Maximum Input Frequency		kHz			1000
	Interpolation of the Signal Period			4 times		
	Marker Pulse Delay, t1		nsec			50
	Time between edges, t2		nsec	250		
General	Ambient Temperature		°C	+5°C to +45°C - Operating Temp -30°C to +85°C - Stor./Trnsprt Temp		
	Allowable humidity as per DIN Humidity Class		%	75% Average, 85% Occasionally DIN 40 040 Class F		
	Weight		g	100		

Incremental Encoder Output Signals



Incremental Encoder Input Circuit



A

DLF 1.1 Linear Encoder Input Card for DDS 2.1 - Technical Specifications

	Description		Units	Min.	Typ.	Max.
Encoder Supply Voltage	Output Voltage		V	4.75	5.0	5.25
	Output Current		mA			150
Linear Encoder Input Signals	Signal Current	I_{e1}; I_{e2}	μAss	7		16
		I_{e0}	μA	2		8
	Phase positions	I_{e1}	°elec.		0	
		I_{e2}	°elec.		90	
	Signal Waveform			Sinusoidal Approximation		
	Maximum Input Frequency		kHz			150
	Interpolation of the Signal Period			2048 times		
General	Ambient Temperature		°C	+5°C to +45°C - Operating Temp -30°C to +85°C - Stor./Trnsprt Temp		
	Allowable humidity as per DIN Humidity Class		%	75% Average, 85% Occasionally DIN 40 040 Class F		
	Weight		g	150		

DDS 2.1 Current Requirements

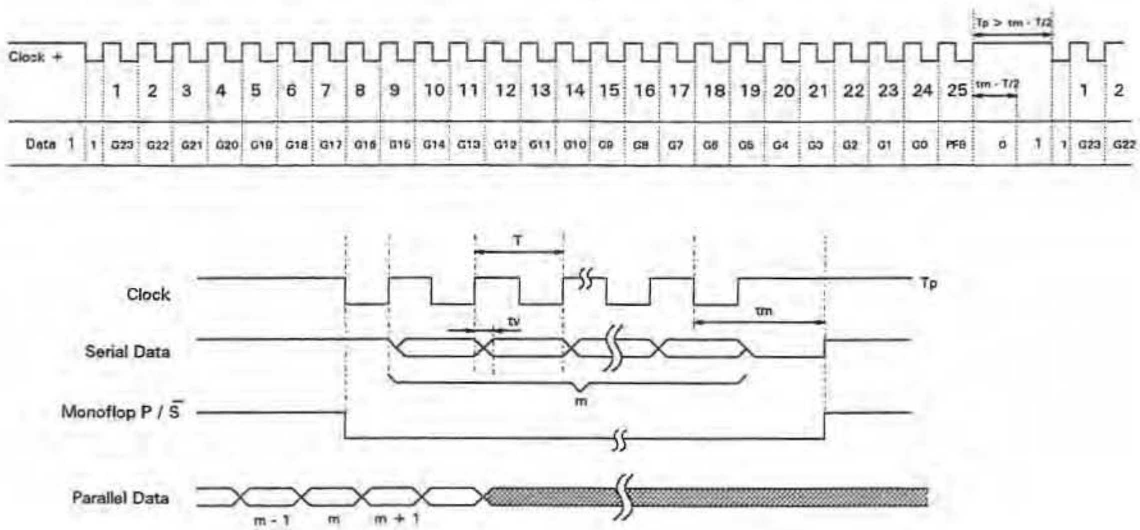
Configured Drives	Maximum Current Requirements (mA)		
	+24V Control Voltage	+15V Control Voltage	-15V Control Voltage
DDS 2.1-...-DA01-00	670	180	180
DDS 2.1-...-DA02-00	700	180	180
DDS 2.1-...-DA03-00	710	180	180
DDS 2.1-...-DS01-00	710	150	150
DDS 2.1-...-DS03-00	890	150	150
DDS 2.1-...-DS04-00	840	190	190
DDS 2.1-...-DS05-00	1040	150	150
DDS 2.1-...-RA01-00	570	200	180
DDS 2.1-...-RA02-00	570	200	180
DDS 2.1-...-RS01-00	610	150	150
DDS 2.1-...-RS03-00	760	170	150
DDS 2.1-...-RS04-00	740	190	190

A

Description of the Synchronous Serial Interface, SSI Data Format

Key Code:	Gray Code
Count Orientation with the Motor Shaft Turning in a Clockwise Direction:	Increasing
Data Transmission:	Synchronous, Serial
Serial Data Output:	Derived from EIA RS 422A short termination (See pg 2)
Monoflop Time, tm:	15µsec < tm < 25µsec
Clock Frequency:	200 KHz
Min. Clock Burst:	30µsec
Data Format:	24 bit

Timing Diagram of the Data Transmission



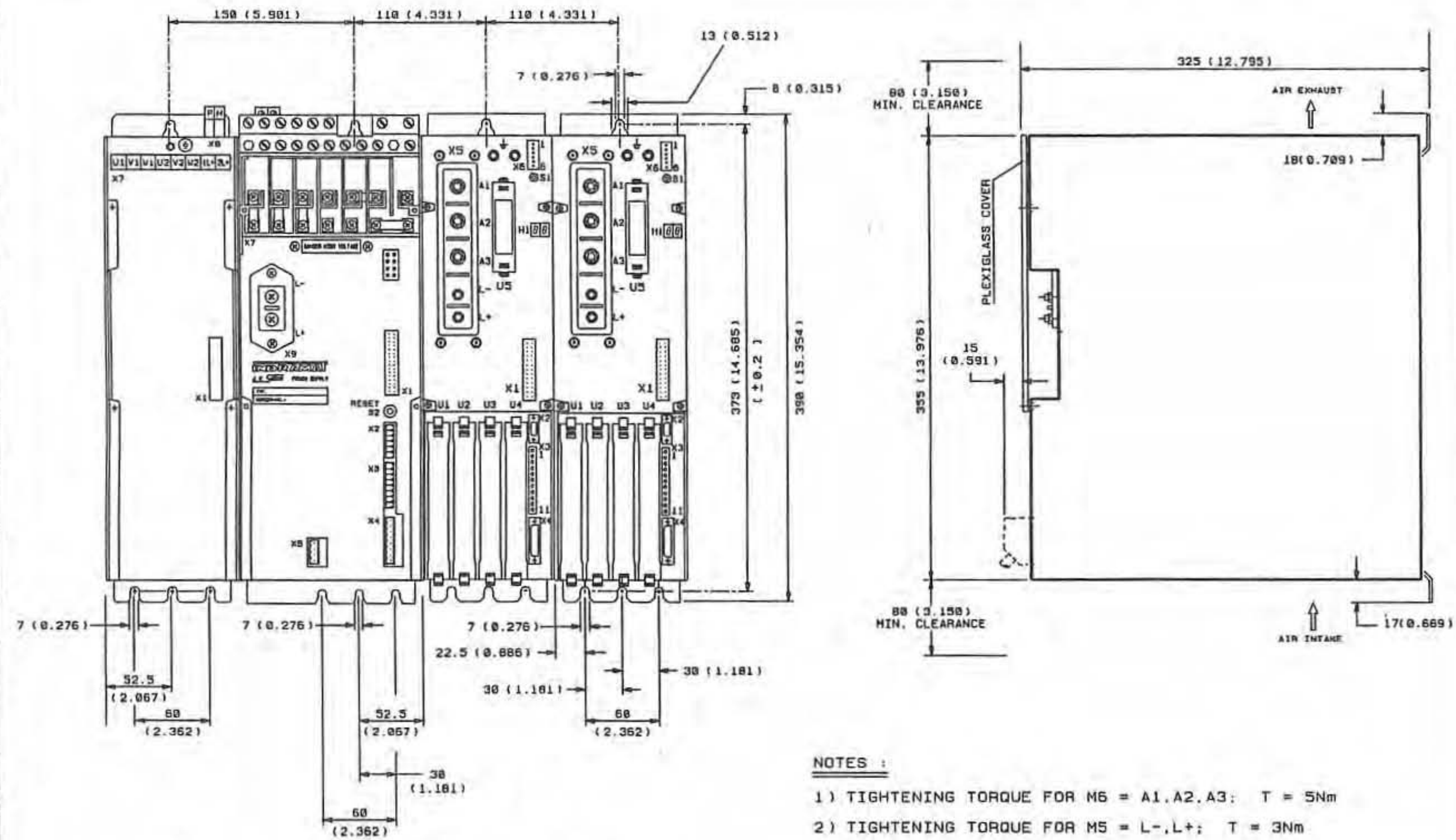
G0	= Least significant bit in the Gray Code
G23	= Most sign. bit in the Gray Code
m	= Stored parallel information
T	= Continuous Periods of the Clock Signal
tm	= Mono flop time, 15µsec to 25µsec
Tp	= Clock interval
tv	= Propogation delay time of the first clock = 540 nsec, for all others = 360 nsec
PFB	= Power Failure Bit

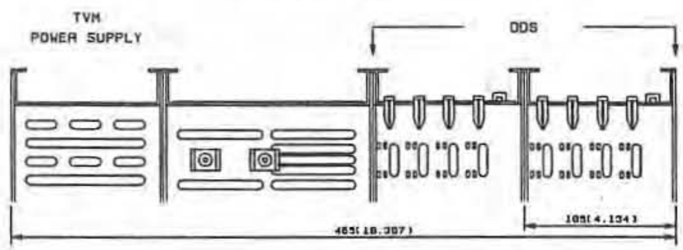
In a situation where the supply voltage goes under 5V for over 100 usec, falsely encoded information can be transmitted. The Power Failure Bit (PFB) identifies this error. In the case of a supply shutdown, a comparator will set the PFB bit in the serial information to a logic "1".

APPENDIX B: OUTLINE DRAWINGS

CAUTION: *Drawings in this Appendix are included for illustrative purposes only and are subject to change without notice. Check with Indramat to be sure you are working with the latest drawings prior to installing, wiring and powering equipment.*

OUTLINE DRAWINGS





NOTES :

1) TIGHTENING TORQUE FOR M6 = A1,A2,A3: T = 5Nm
2) TIGHTENING TORQUE FOR M5 = L-,L+: T = 3Nm
3) TIGHTENING TORQUE FOR 2 x M5 = ⏚ : T = 3Nm
4) ALL DIMENSIONS SHOWN IN "mm", (INCH) FOR REFERENCE ONLY.

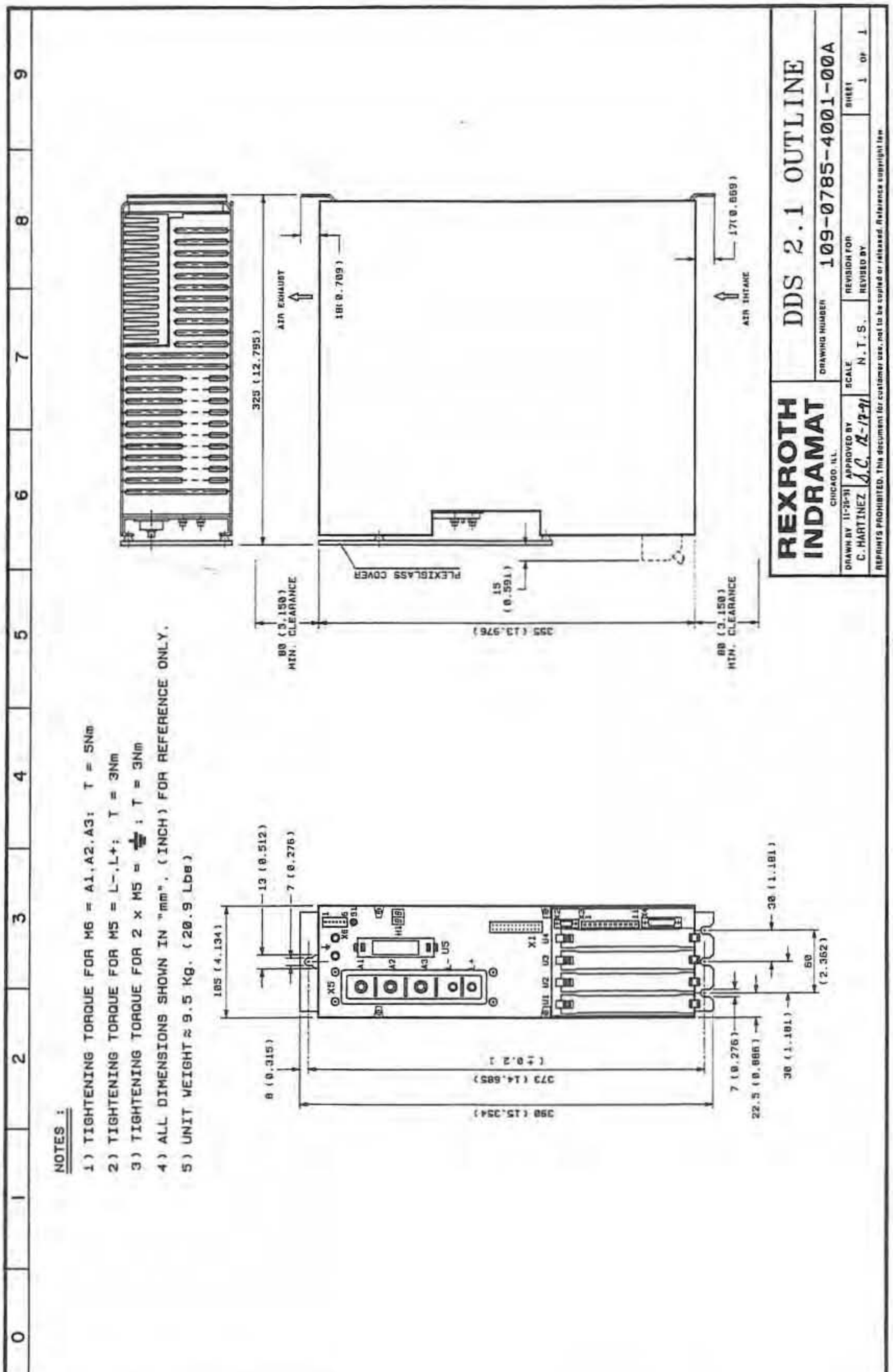
PRELIMINARY

REXROTH INDRAMAT WOOD DALE, IL.

QUALITY DRIVES INDRAMAT

IAE 74795
DDS 2.1

B


NOTES :
1) TIGHTENING TORQUE FOR M6 = A1,A2,A3; T = 5Nm
2) TIGHTENING TORQUE FOR M5 = L-,L+; T = 3Nm
3) TIGHTENING TORQUE FOR 2 x M5 = ⏚ ; T = 3Nm
4) ALL DIMENSIONS SHOWN IN "mm". (INCH) FOR REFERENCE ONLY.
5) UNIT WEIGHT ≈ 9.5 Kg. (20.9 Lbs)
AIR EXHAUST
AIR INTAKE
PLEXIGLASS COVER
325 (12.795)
355 (13.976)
80 (3.150) MIN. CLEARANCE
15 (0.591)
18 (0.709)
17 (0.669)
105 (4.134)
13 (0.512)
7 (0.276)
8 (0.315)
373 (14.685)
390 (15.354)
30 (1.181)
60 (2.362)
22.5 (0.886)
REXROTH
INDRAMAT
CHICAGO ILL.
DDS 2.1 OUTLINE
DRAWING NUMBER
109-0785-4001-00A
DRAWN BY C. MARTINEZ
APPROVED BY
SCALE N.T.S.
REVISION FOR
REVISED BY
SHEET 1 OF 1
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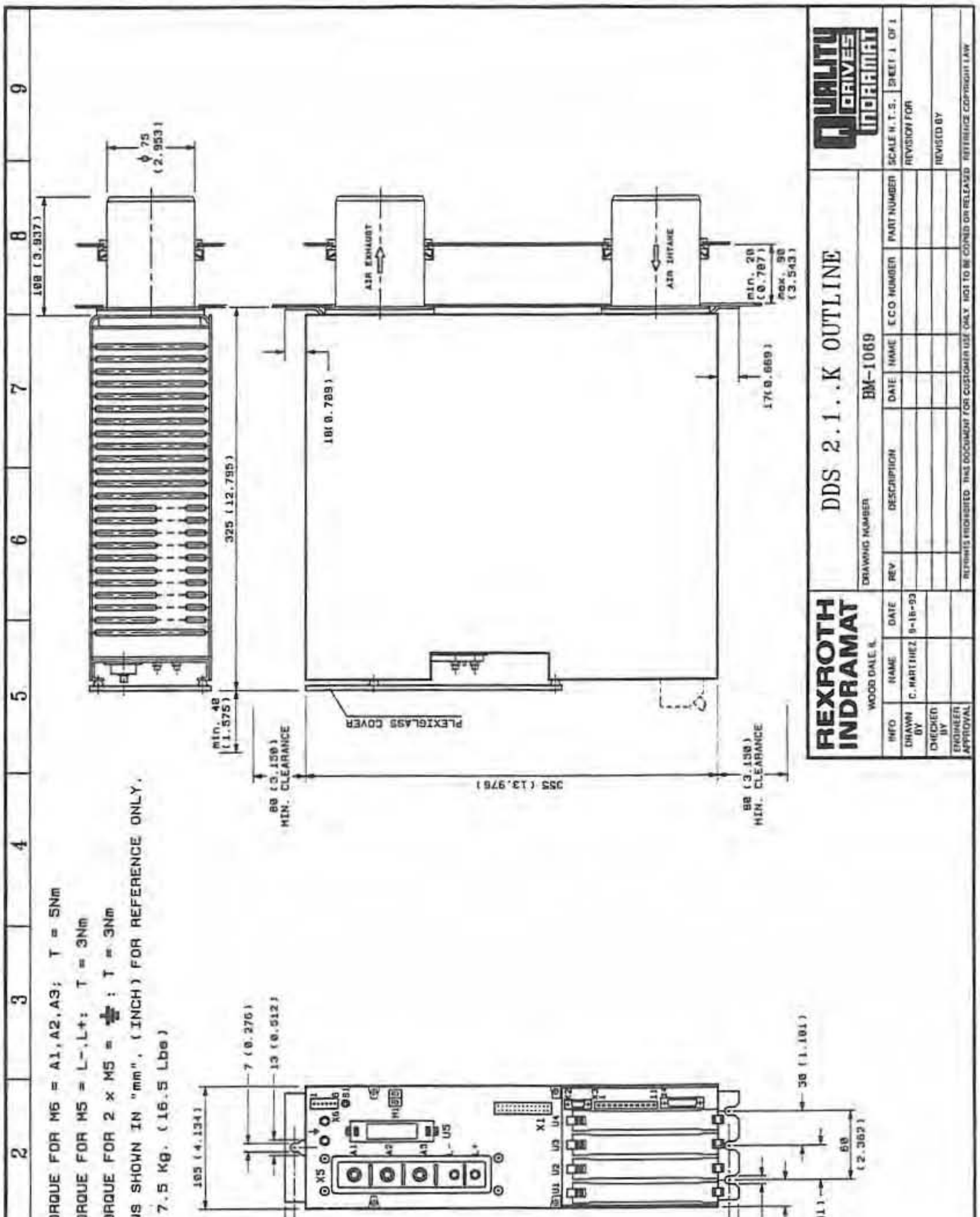
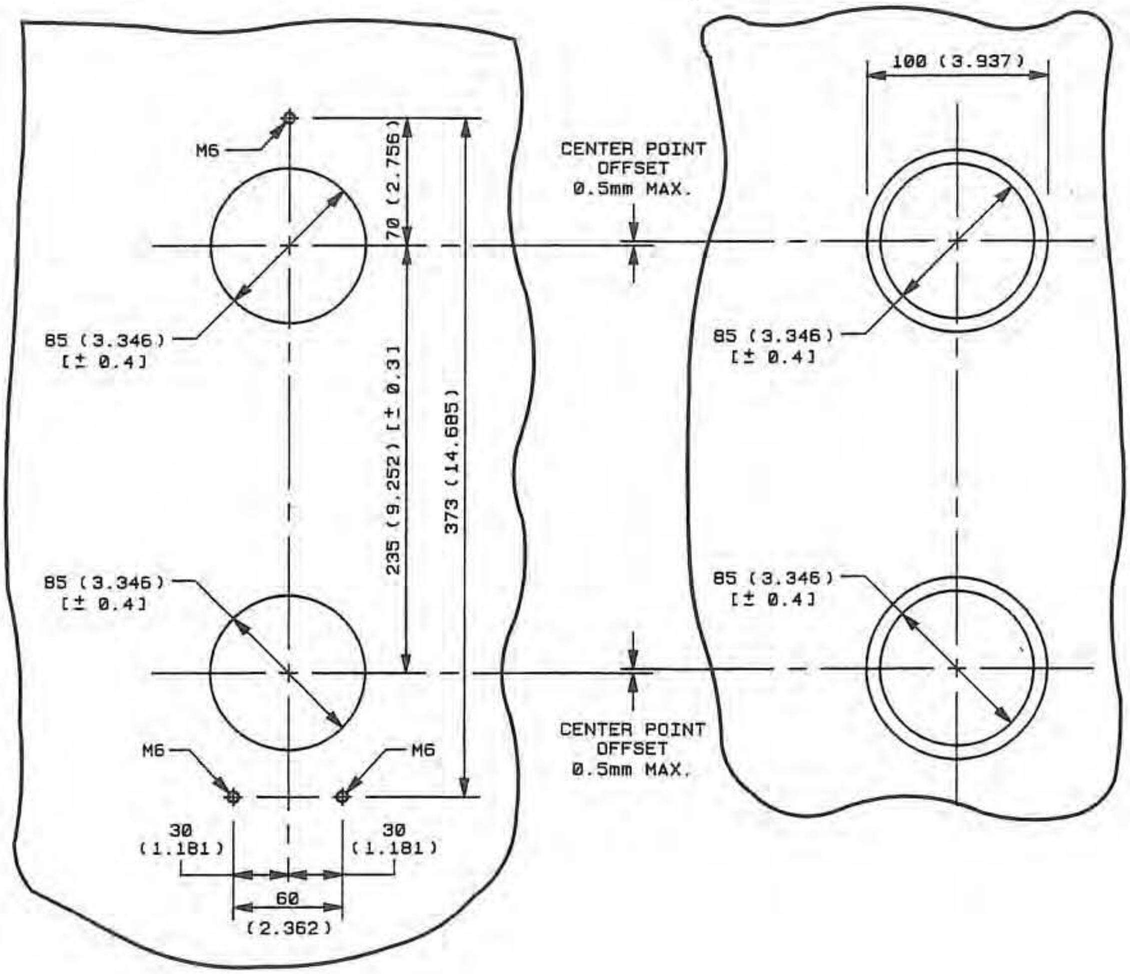

NOTES :
1) TIGHTENING TORQUE FOR M6 = A1,A2,A3; T = 5Nm
2) TIGHTENING TORQUE FOR M5 = L-,L+: T = 3Nm
3) TIGHTENING TORQUE FOR 2 x M5 = ⏚ : T = 3Nm
4) ALL DIMENSIONS SHOWN IN "mm". (INCH) FOR REFERENCE ONLY.
5) UNIT WEIGHT ≈ 7.5 Kg. (16.5 Lbs)
105 (4.134)
8 (0.315)
7 (0.276)
13 (0.512)
390 (15.354)
373 (14.685)
(±0.2)
X5
X6
A1
A2
A3
L-
L+
U5
X1
U1 U2 U3 U4
7 (0.276)
22.5 (0.886)
30 (1.181)
30 (1.181)
60
(2.362)
100 (3.937)
ϕ 75
(2.953)
min. 40
(1.575)
325 (12.795)
80 (3.150)
MIN. CLEARANCE
18(0.709)
PLEXIGLASS COVER
AIR EXHAUST
AIR INTAKE
355 (13.976)
80 (3.150)
MIN. CLEARANCE
17(0.669)
min. 20
(0.787)
max. 90
(3.543)
REXROTH
INDRAMAT
WOOD DALE, IL
DDS 2.1..K OUTLINE
DRAWING NUMBER
BM-1069
QUALITY DRIVES INDRAMAT
INFO
NAME
DATE
DRAWN BY
C.MARTINEZ
9-16-93
CHECKED BY
ENGINEER APPROVAL
REV
DESCRIPTION
DATE
NAME
E.C.O NUMBER
PART NUMBER
SCALE N.T.S.
SHEET 1 OF 1
REVISION FOR
REVISED BY
REPRINTS PROHIBITED. THIS DOCUMENT FOR CUSTOMER USE ONLY. NOT TO BE COPIED OR RELEASED. REFERENCE COPYRIGHT LAW

B



REXROTH INDRAMAT WOOD DALE, IL.			MOUNTING DIMENSIONS FOR DDS 2 COLD MODULE						QUALITY DRIVES INDRAMAT
			DRAWING NUMBER AM - 1060						
INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S. SHEET 1 OF 1
DRAWN BY	C.MARTINEZ	9-16-93							REVISION FOR
CHECKED BY									REVISED BY
ENGINEER APPROVAL			REPRINTS PROHIBITED. THIS DOCUMENT FOR CUSTOMER USE ONLY. NOT TO BE COPIED OR RELEASED. REFERENCE COPYRIGHT LAW.						

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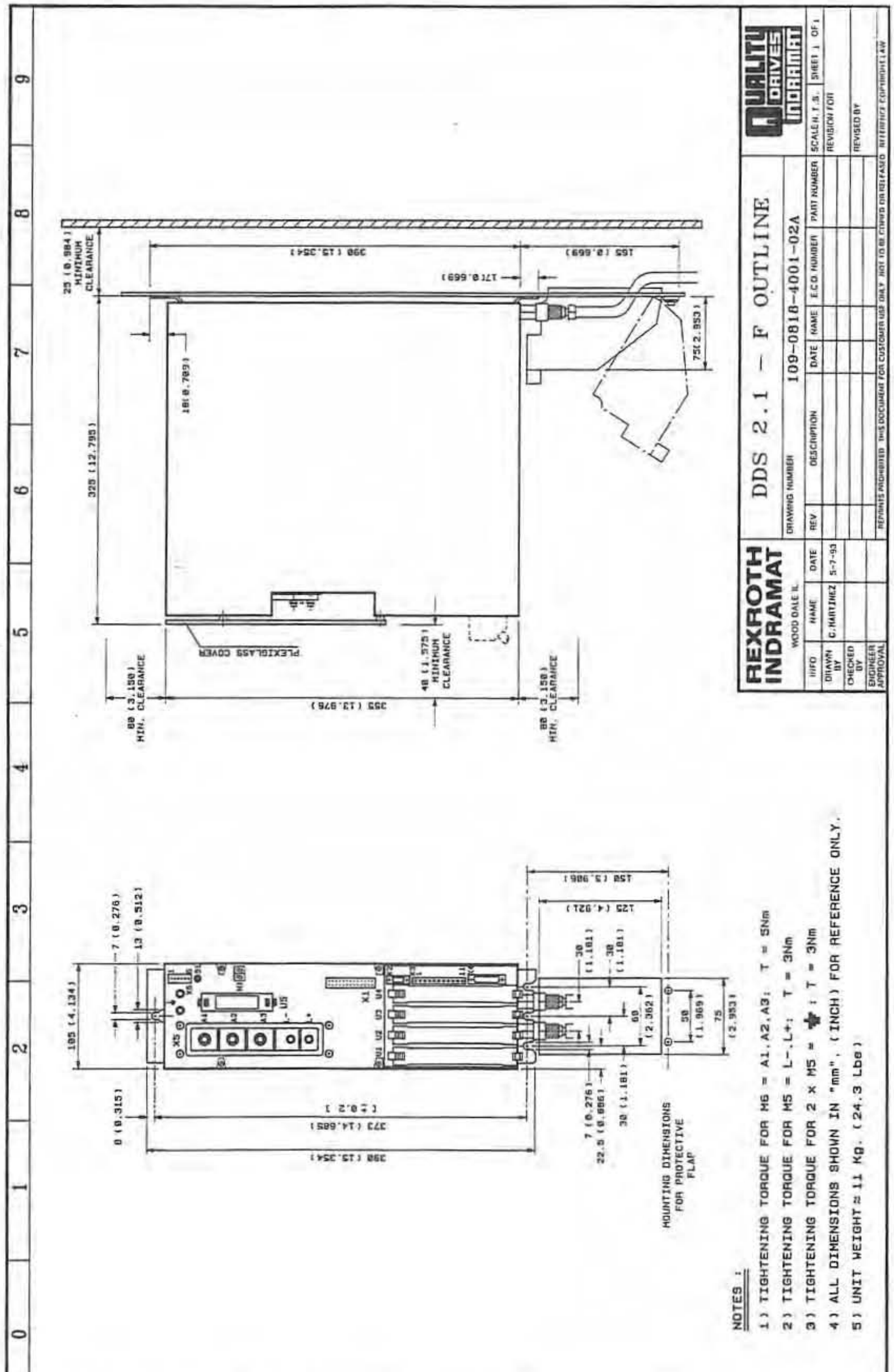
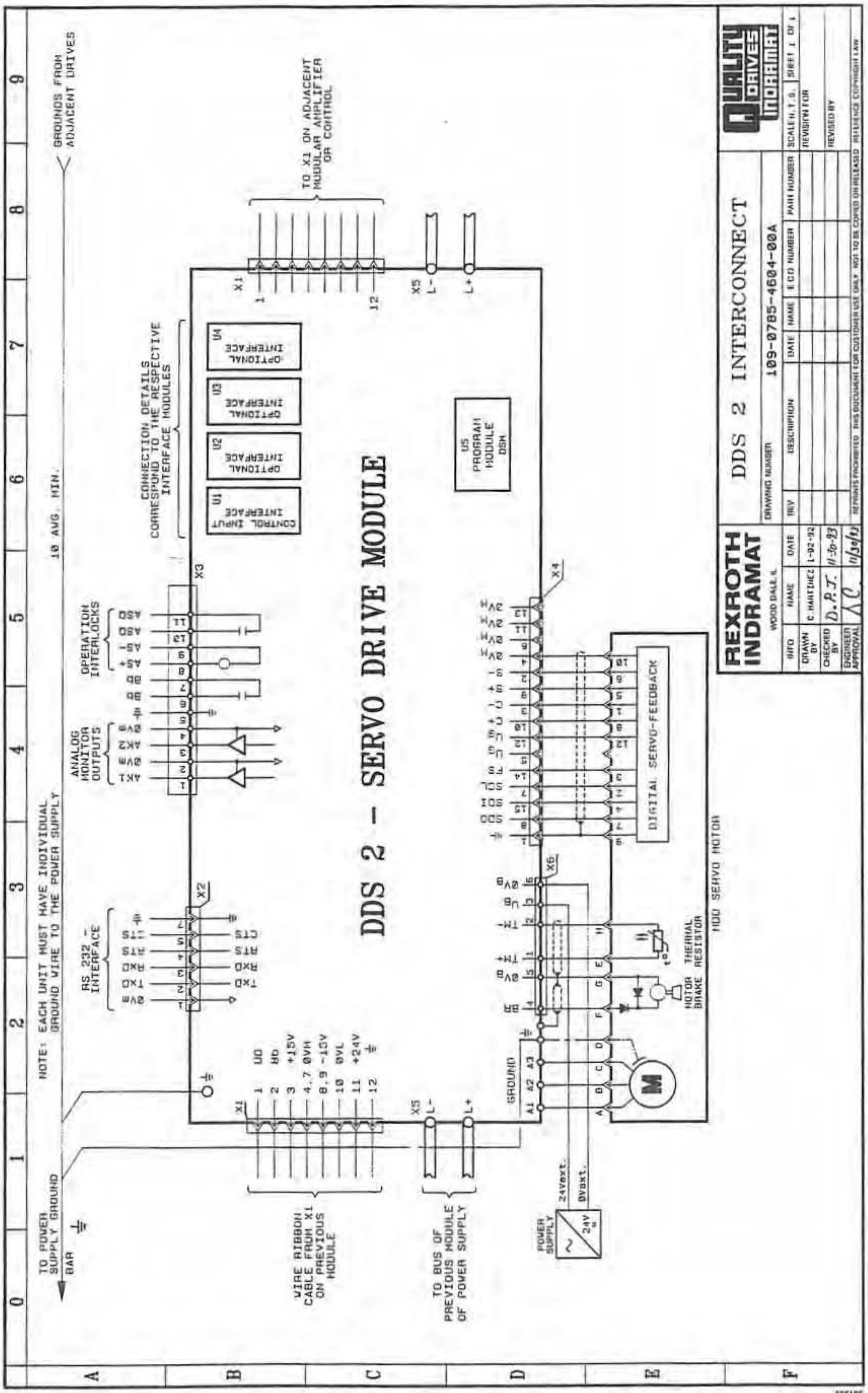
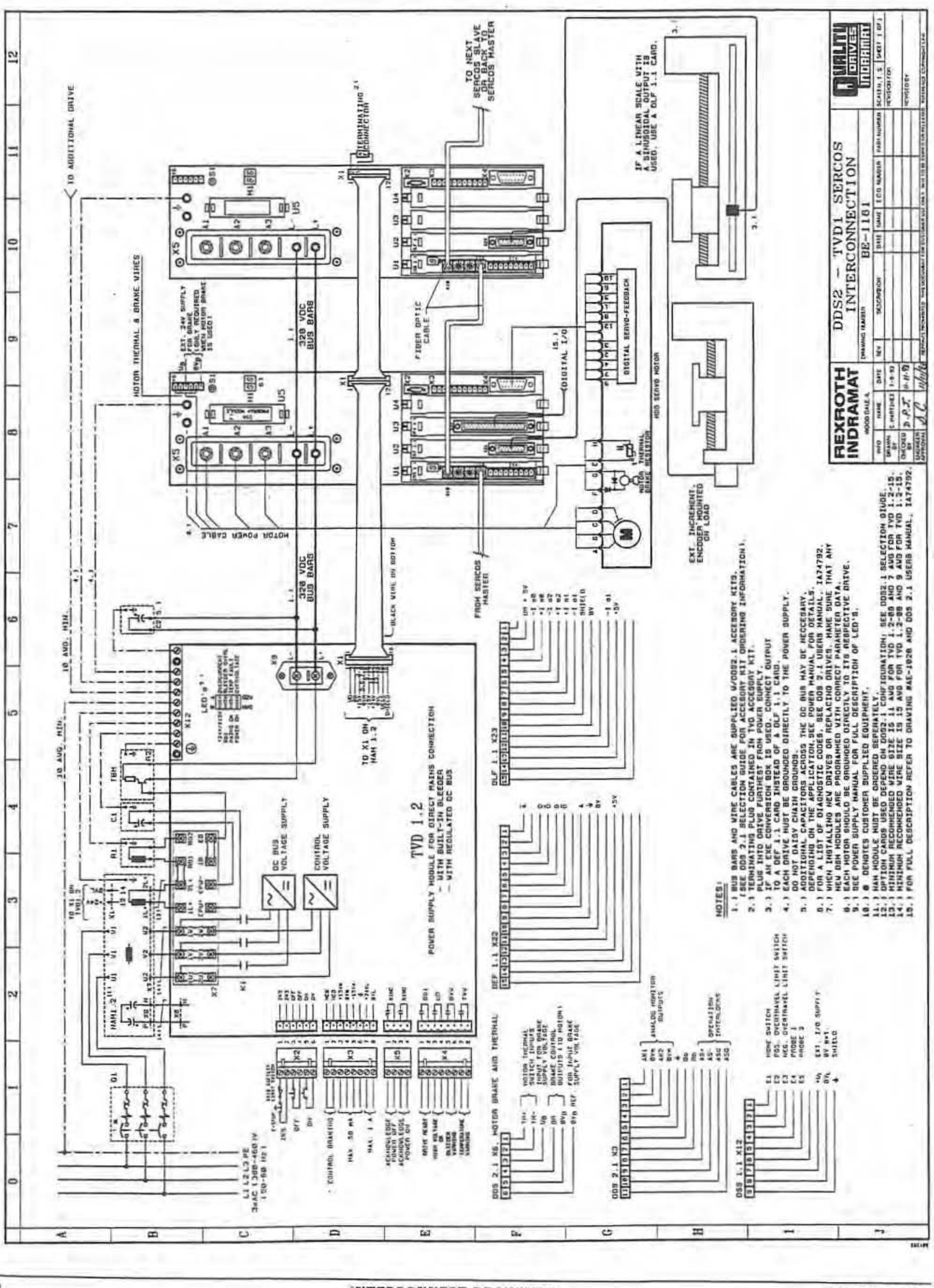
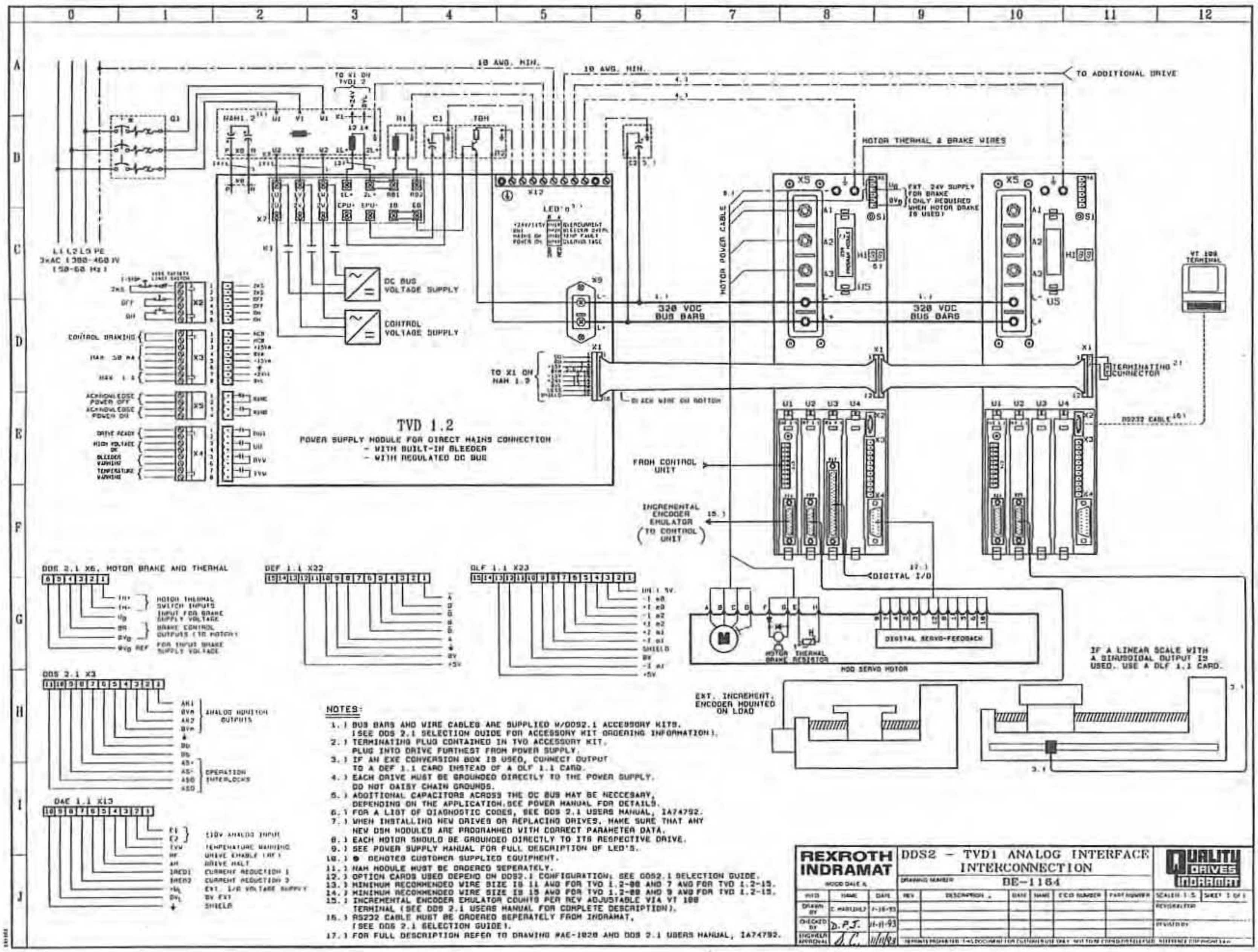

NOTES :
1) TIGHTENING TORQUE FOR M6 = A1,A2,A3; T = 5Nm
2) TIGHTENING TORQUE FOR M5 = L-,L+; T = 3Nm
3) TIGHTENING TORQUE FOR 2 x M5 = ⏚ ; T = 3Nm
4) ALL DIMENSIONS SHOWN IN "mm", (INCH) FOR REFERENCE ONLY.
5) UNIT WEIGHT ≈ 11 Kg. (24.3 Lbs)
MOUNTING DIMENSIONS FOR PROTECTIVE FLAP
PLEXIGLASS COVER
MIN. CLEARANCE
MINIMUM CLEARANCE
REXROTH INDRAMAT
DDS 2.1 – F OUTLINE
109-0818-4001-02A
C. MARTINEZ
5-7-93

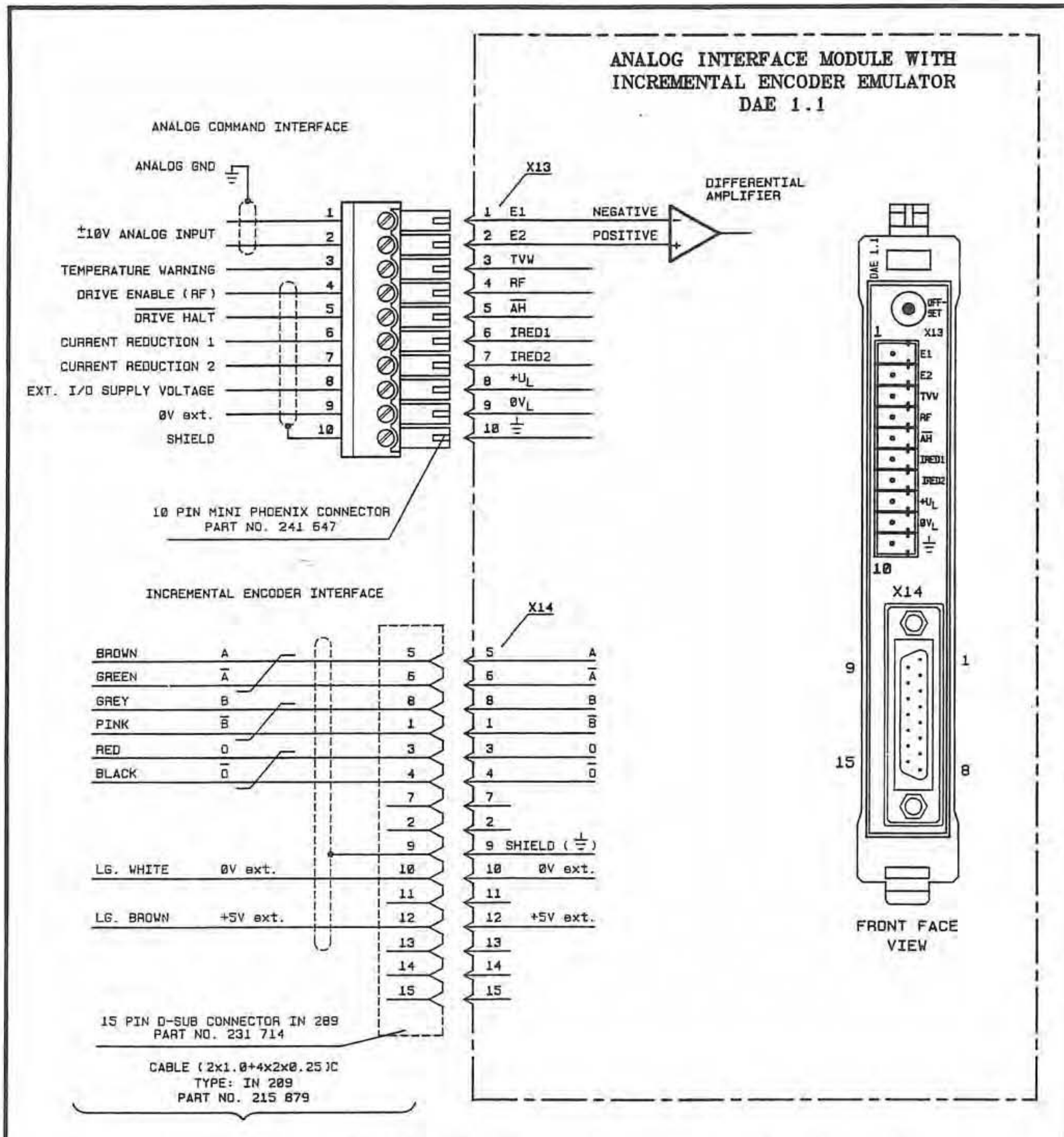
APPENDIX C: INTERCONNECT DRAWINGS

CAUTION: *Drawings in this Appendix are included for illustrative purposes only and are subject to change without notice. Check with Indramat to be sure you are working with the latest drawings prior to installing, wiring and powering equipment.*


DDS 2 – SERVO DRIVE MODULE
NOTE: EACH UNIT MUST HAVE INDIVIDUAL GROUND WIRE TO THE POWER SUPPLY
10 AWG. MIN.
TO POWER SUPPLY GROUND BAR
GROUNDS FROM ADJACENT DRIVES
RS 232 - INTERFACE
ANALOG MONITOR OUTPUTS
OPERATION INTERLOCKS
CONNECTION DETAILS CORRESPOND TO THE RESPECTIVE INTERFACE MODULES
U1 CONTROL INPUT INTERFACE
U2 OPTIONAL INTERFACE
U3 OPTIONAL INTERFACE
U4 OPTIONAL INTERFACE
U5 PROGRAM MODULE DSM
TO X1 ON ADJACENT MODULAR AMPLIFIER OR CONTROL
WIRE RIBBON CABLE FROM X1 ON PREVIOUS MODULE
TO BUS OF PREVIOUS MODULE OF POWER SUPPLY
POWER SUPPLY
24Vext.
0Vext.
GROUND
MOTOR BRAKE
THERMAL RESISTOR
MDD SERVO MOTOR
DIGITAL SERVO-FEEDBACK
REXROTH INDRAMAT
DDS 2 INTERCONNECT
109-0785-4604-00A
QUALITY DRIVES INDRAMAT


10 AWG. MIN.
TO ADDITIONAL DRIVE
MOTOR THERMAL & BRAKE WIRES
EXT. 24V SUPPLY FOR BRAKE (ONLY REQUIRED WHEN MOTOR BRAKE IS USED)
MOTOR POWER CABLE
L1 L2 L3 PE
3xAC (300-460)V
(50-60 Hz)
DC BUS VOLTAGE SUPPLY
CONTROL VOLTAGE SUPPLY
320 VDC BUS BARS
TO X1 ON HAM 1.2
BLACK WIRE ON BOTTOM
TERMINATING CONNECTOR
TVD 1.2
POWER SUPPLY MODULE FOR DIRECT MAINS CONNECTION
- WITH BUILT-IN BLEEDER
- WITH REGULATED DC BUS
FIBER OPTIC CABLE
FROM SERCOS MASTER
TO NEXT SERCOS SLAVE OR BACK TO SERCOS MASTER
DDS 2.1 X6, MOTOR BRAKE AND THERMAL
MOTOR THERMAL SWITCH INPUTS
INPUT FOR BRAKE SUPPLY VOLTAGE
BRAKE CONTROL OUTPUTS (TO MOTOR)
FOR INPUT BRAKE SUPPLY VOLTAGE
DEF 1.1 X22
DLF 1.1 X23
DIGITAL I/O
DIGITAL SERVO-FEEDBACK
MOTOR THERMAL
BRAKE RESISTOR
MDD SERVO MOTOR
DDS 2.1 X3
ANALOG MONITOR OUTPUTS
OPERATION INTERLOCKS
DSS 1.1 X12
HOME SWITCH
POS. OVERTRAVEL LIMIT SWITCH
NEG. OVERTRAVEL LIMIT SWITCH
PROBE 1
PROBE 2
EXT. I/O SUPPLY
SHIELD
EXT. INCREMENT. ENCODER MOUNTED ON LOAD
IF A LINEAR SCALE WITH A SINUSOIDAL OUTPUT IS USED, USE A DLF 1.1 CARD.
NOTES:
1.) BUS BARS AND WIRE CABLES ARE SUPPLIED W/DDS2.1 ACCESORY KITS.
(SEE DDS 2.1 SELECTION GUIDE FOR ACCESORY KIT ORDERING INFORMATION).
2.) TERMINATING PLUG CONTAINED IN TVD ACCESORY KIT.
PLUG INTO DRIVE FURTHEST FROM POWER SUPPLY.
3.) IF AN EXE CONVERSION BOX IS USED, CONNECT OUTPUT
TO A DEF 1.1 CARD INSTEAD OF A DLF 1.1 CARD.
4.) EACH DRIVE MUST BE GROUNDED DIRECTLY TO THE POWER SUPPLY.
DO NOT DAISY CHAIN GROUNDS.
5.) ADDITIONAL CAPACITORS ACROSS THE DC BUS MAY BE NECCESARY,
DEPENDING ON THE APPLICATION, SEE POWER MANUAL FOR DETAILS.
6.) FOR A LIST OF DIAGNOSTIC CODES, SEE DDS 2.1 USERS MANUAL, IA74792.
7.) WHEN INSTALLING NEW DRIVES OR REPLACING DRIVES, MAKE SURE THAT ANY
NEW DSM MODULES ARE PROGRAMMED WITH CORRECT PARAMETER DATA.
8.) EACH MOTOR SHOULD BE GROUNDED DIRECTLY TO ITS RESPECTIVE DRIVE.
9.) SEE POWER SUPPLY MANUAL FOR FULL DESCRIPTION OF LED'S.
10.) @ DENOTES CUSTOMER SUPPLIED EQUIPMENT.
11.) HAM MODULE MUST BE ORDERED SEPERATELY.
12.) OPTION CARDS USED DEPEND ON DDS2.1 CONFIGURATION; SEE DDS2.1 SELECTION GIUDE.
13.) MINIMUM RECOMMENDED WIRE SIZE IS 11 AWG FOR TVD 1.2-08 AND 7 AWG FOR TVD 1.2-15.
14.) MINIMUM RECOMMENDED WIRE SIZE IS 15 AWG FOR TVD 1.2-08 AND 9 AWG FOR TVD 1.2-15.
15.) FOR FULL DESCRIPTION REFER TO DRAWING #AE-1020 AND DDS 2.1 USERS MANUAL, IA74792.
REXROTH INDRAMAT
DDS2 - TVD1 SERCOS INTERCONNECTION
BE-1161
QUALITY DRIVES INDRAMAT


TVD 1.2
POWER SUPPLY MODULE FOR DIRECT MAINS CONNECTION
- WITH BUILT-IN BLEEDER
- WITH REGULATED DC BUS
DC BUS VOLTAGE SUPPLY
CONTROL VOLTAGE SUPPLY
320 VDC BUS BARS
MOTOR POWER CABLE
MOTOR THERMAL & BRAKE WIRES
TO ADDITIONAL DRIVE
TERMINATING CONNECTOR
RS232 CABLE
VT 100 TERMINAL
FROM CONTROL UNIT
INCREMENTAL ENCODER EMULATOR (TO CONTROL UNIT)
DIGITAL I/O
DIGITAL SERVO-FEEDBACK
MDD SERVO MOTOR
EXT. INCREMENT. ENCODER MOUNTED ON LOAD
IF A LINEAR SCALE WITH A SINUSOIDAL OUTPUT IS USED, USE A DLF 1.1 CARD.
DDS 2.1 X6, MOTOR BRAKE AND THERMAL
DEF 1.1 X22
DLF 1.1 X23
DDS 2.1 X3
DAE 1.1 X13
NOTES:
1.) BUS BARS AND WIRE CABLES ARE SUPPLIED W/DDS2.1 ACCESSORY KITS. (SEE DDS 2.1 SELECTION GUIDE FOR ACCESSORY KIT ORDERING INFORMATION).
2.) TERMINATING PLUG CONTAINED IN TVD ACCESSORY KIT. PLUG INTO DRIVE FURTHEST FROM POWER SUPPLY.
3.) IF AN EXE CONVERSION BOX IS USED, CONNECT OUTPUT TO A DEF 1.1 CARD INSTEAD OF A DLF 1.1 CARD.
4.) EACH DRIVE MUST BE GROUNDED DIRECTLY TO THE POWER SUPPLY. DO NOT DAISY CHAIN GROUNDS.
5.) ADDITIONAL CAPACITORS ACROSS THE DC BUS MAY BE NECCESARY, DEPENDING ON THE APPLICATION. SEE POWER MANUAL FOR DETAILS.
6.) FOR A LIST OF DIAGNOSTIC CODES, SEE DDS 2.1 USERS MANUAL, IA74792.
7.) WHEN INSTALLING NEW DRIVES OR REPLACING DRIVES, MAKE SURE THAT ANY NEW DSM MODULES ARE PROGRAMMED WITH CORRECT PARAMETER DATA.
8.) EACH MOTOR SHOULD BE GROUNDED DIRECTLY TO ITS RESPECTIVE DRIVE.
9.) SEE POWER SUPPLY MANUAL FOR FULL DESCRIPTION OF LED'S.
10.) ● DENOTES CUSTOMER SUPPLIED EQUIPMENT.
11.) NAM MODULE MUST BE ORDERED SEPERATELY.
12.) OPTION CARDS USED DEPEND ON DDS2.1 CONFIGURATION; SEE DDS2.1 SELECTION GUIDE.
13.) MINIMUM RECOMMENDED WIRE SIZE IS 11 AWG FOR TVD 1.2-08 AND 7 AWG FOR TVD 1.2-15.
14.) MINIMUM RECOMMENDED WIRE SIZE IS 15 AWG FOR TVD 1.2-08 AND 9 AWG FOR TVD 1.2-15.
15.) INCREMENTAL ENCODER EMULATOR COUNTS PER REV ADJUSTABLE VIA VT 100 TERMINAL (SEE DDS 2.1 USERS MANUAL FOR COMPLETE DESCRIPTION).
16.) RS232 CABLE MUST BE ORDERED SEPERATELY FROM INDRAMAT, (SEE DDS 2.1 SELECTION GUIDE).
17.) FOR FULL DESCRIPTION REFER TO DRAWING #AE-1020 AND DDS 2.1 USERS MANUAL, IA74792.
REXROTH INDRAMAT
DDS2 - TVD1 ANALOG INTERFACE INTERCONNECTION
BE-1164
QUALITY DRIVES INDRAMAT



FOR MORE SPECIFIC TECHNICAL DATA SEE: SPECIFICATION SHEET 109-0785-4105-00A

REXROTH INDRAMAT
WOOD DALE, IL.

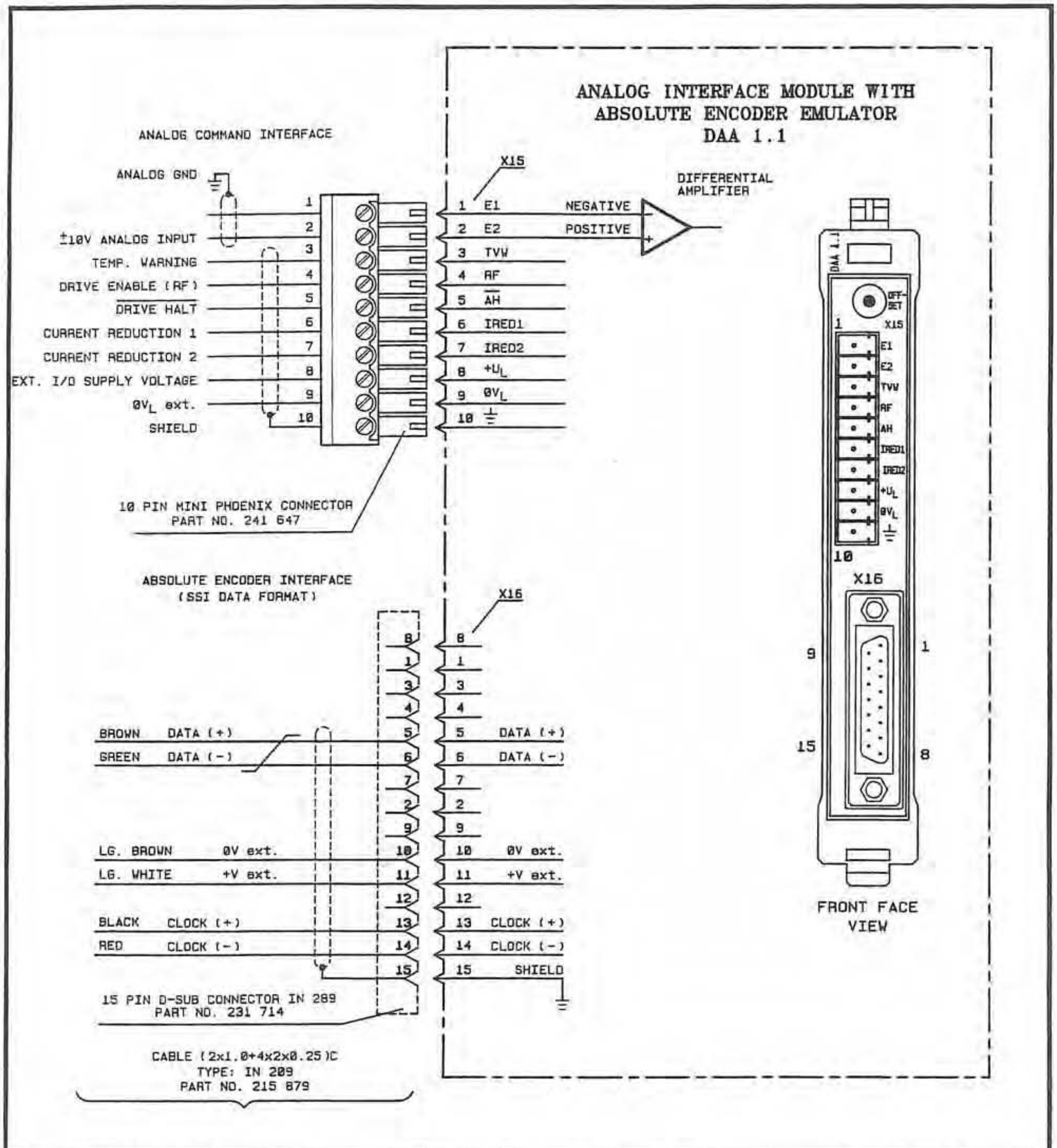
ANALOG INTERFACE MODULE WITH INCREMENTAL ENCODER EMULATOR INTERCONNECTION

DRAWING NUMBER 109-0785-4602-00A

QUALITY DRIVES INDRAMAT

INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 1
DRAWN BY	C.MARTINEZ	1-15-92	A	REVISED PER E.C.O.	2-8-94	C.M.	940208-01		REVISION FOR	
CHECKED BY	D.P.J.	11-10-93							REVISED BY	
ENGINEER APPROVAL	A.C.	11/10/93								

559335



REXROTH INDRAMAT WOOD DALE, IL.	ANALOG INTERFACE MODULE WITH ABSOLUTE ENCODER EMULATOR INTERCONNECTION						QUALITY DRIVES INDRAMAT
	DRAWING NUMBER	109-0785-4102-00A					

INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 1
DRAWN BY	C.MARTINEZ	11-20-92	A	REVISED PER E.C.D.	2-8-94	C.M.	940208-01		REVISION FOR	
CHECKED BY	D.P.J.	11-10-93							REVISED BY	
ENGINEER APPROVAL	S.C.	11/10/93								

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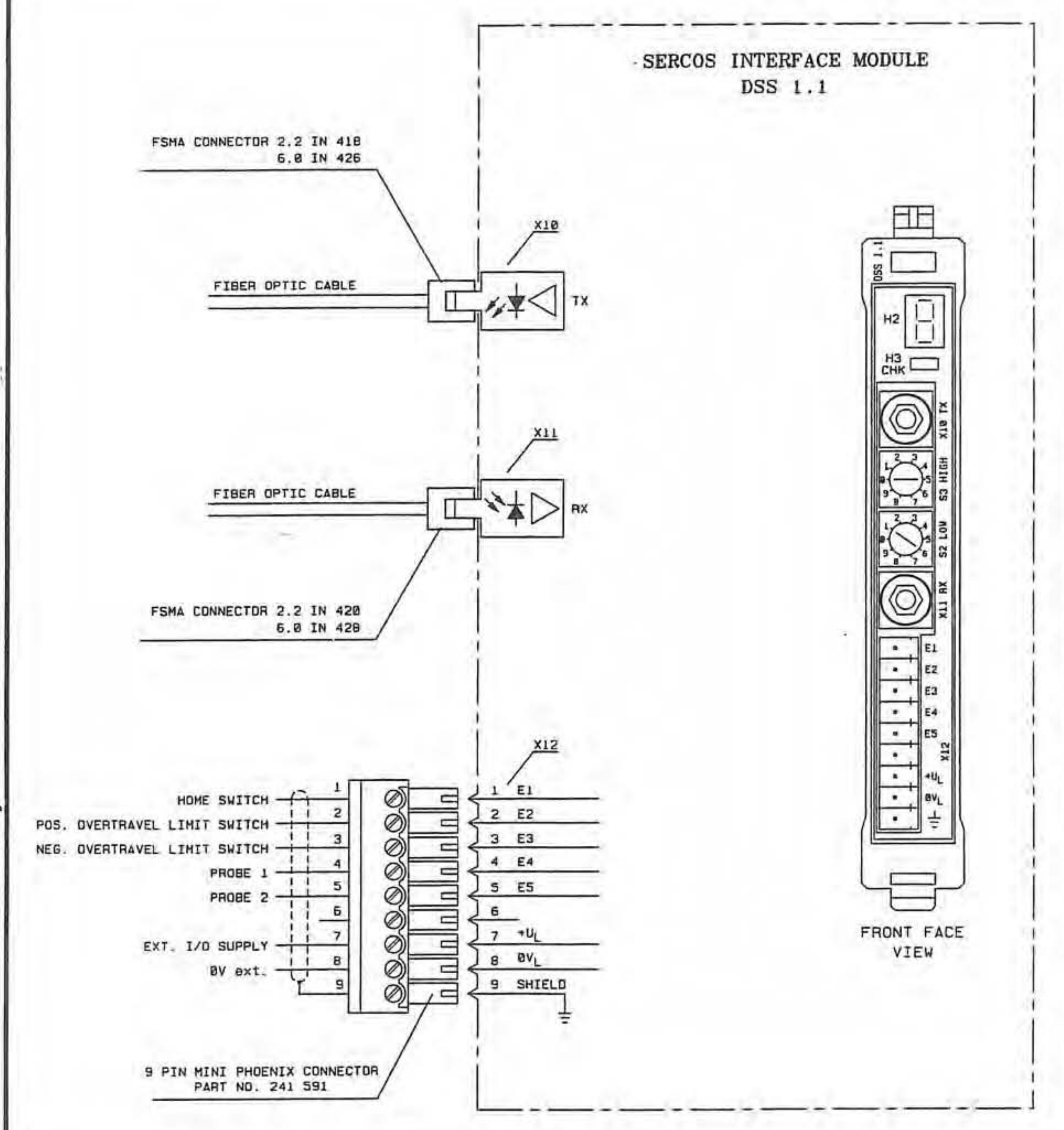
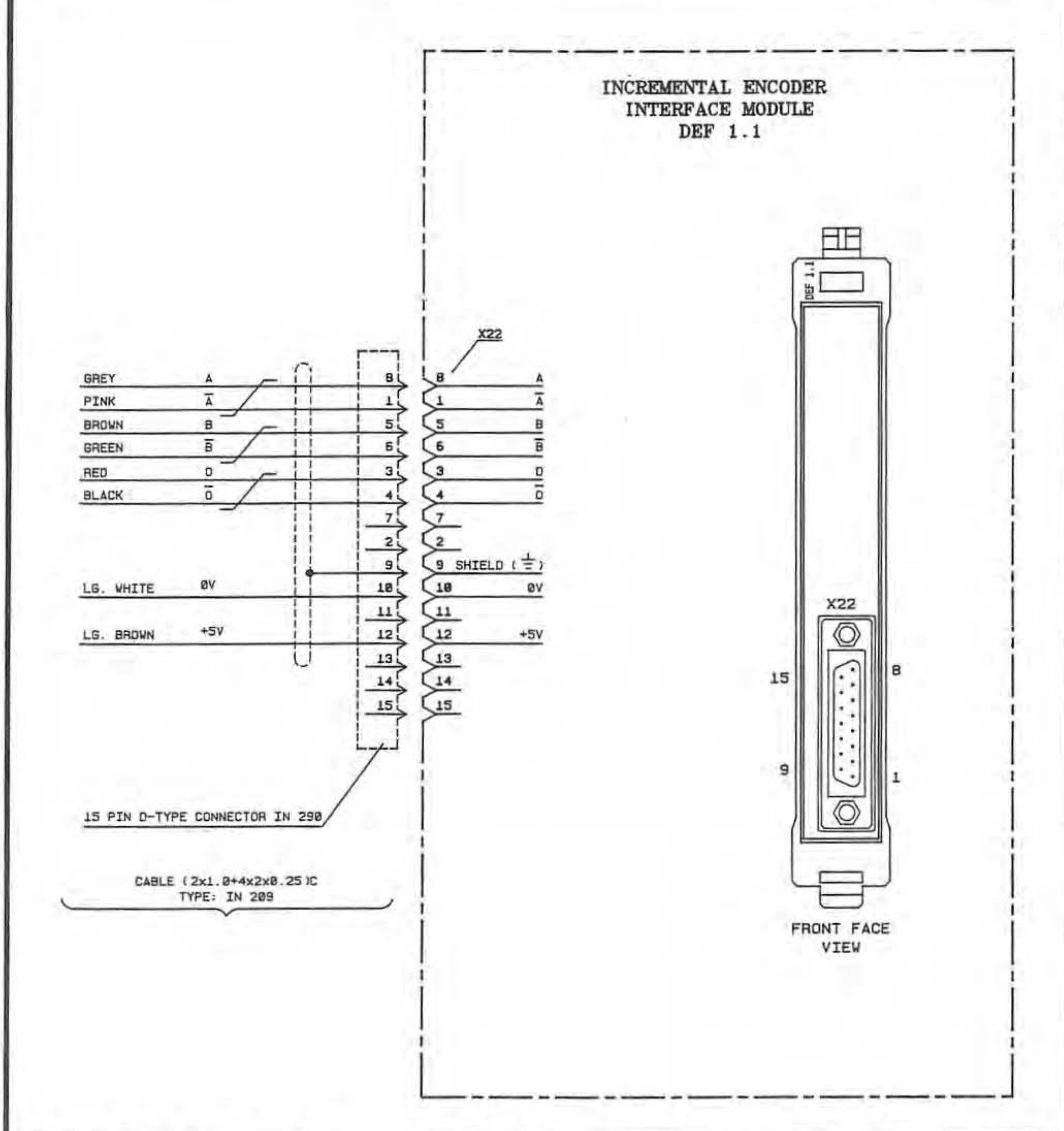


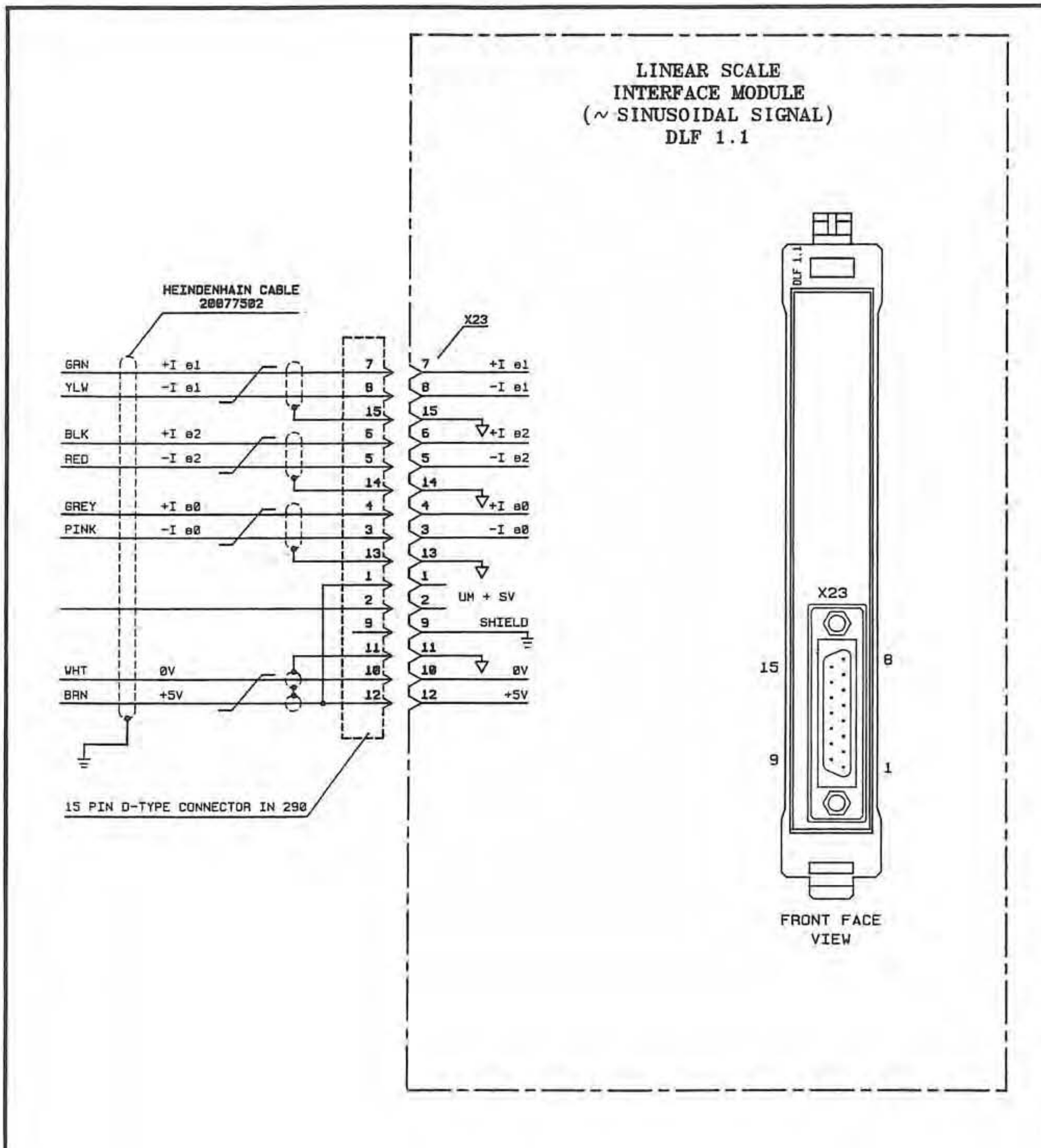
REXROTH INDRAMAT WOOD DALE, IL.	SERCOS INTERFACE MODULE DSS 1.1 INTERCONNECTION					QUALITY DRIVES INDRAMAT
	DRAWING NUMBER 109-0785-4610-00A					

INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 1
DRAWN BY	C.MARTINEZ	1-15-92							REVISION FOR	
CHECKED BY									REVISED BY	
ENGINEER APPROVAL										

547159



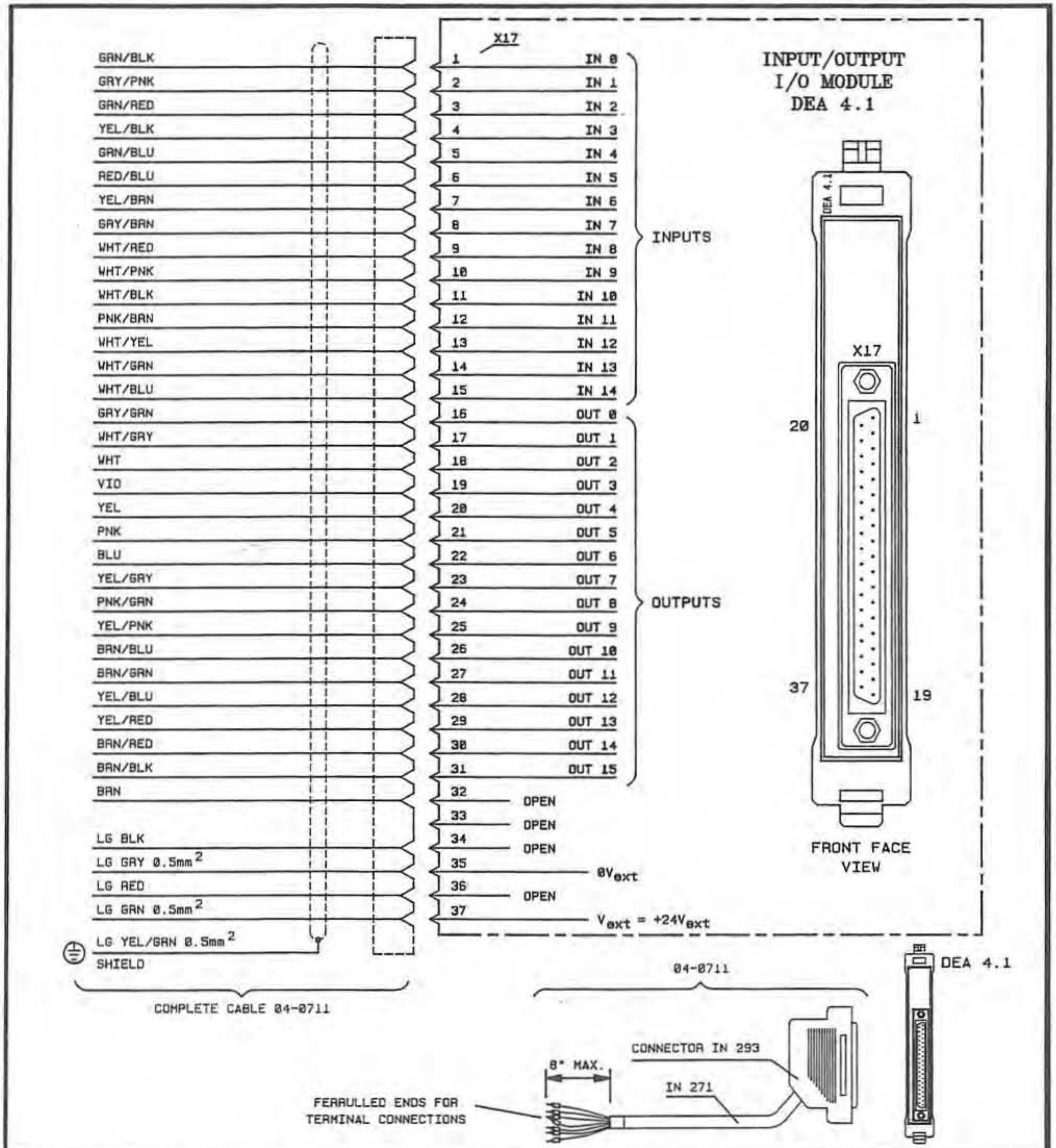
REXROTH INDRAMAT CHICAGO ILL.	INCREMENTAL ENCODER INTERFACE MODULE DEF 1.1 INTERCONNECTION			Rev.	Description	Date	Init.
	DRAWING NUMBER 109-0785-4607-00A						
DRAWN BY 1-15-92 C. MARTINEZ	APPROVED BY	SCALE N.T.S.	REVISION FOR / REVISED BY	SHEET 1 OF 1			



REXROTH INDRAMAT WOOD DALE, IL.			LINEAR SCALE INTERFACE MODULE DLF 1.1 INTERCONNECTION DRAWING NUMBER						QUALITY DRIVES INDRAMAT	
INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 1
DRAWN BY	C. MARTINEZ	8-5-92							REVISION FOR	
CHECKED BY									REVISED BY	
ENGINEER APPROVAL			REPRINTS PROHIBITED. THIS DOCUMENT FOR CUSTOMER USE ONLY. NOT TO BE COPIED OR RELEASED. REFERENCE COPYRIGHT LAW.							

551202

C



REXROTH INDRAMAT WOOD DALE, IL			INPUT/OUTPUT MODULE DEA 4.1						QUALITY DRIVES INDRAMAT
			DRAWING NUMBER AE-1028						
INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S. SHEET 1 OF 1
DRAWN BY	C.MARTINEZ	07-13-93							REVISION FOR
CHECKED BY									REVISED BY
ENGINEER APPROVAL			REPRINTS PROHIBITED. THIS DOCUMENT FOR CUSTOMER USE ONLY. NOT TO BE COPIED OR RELEASED. REFERENCE COPYRIGHT LAW.						

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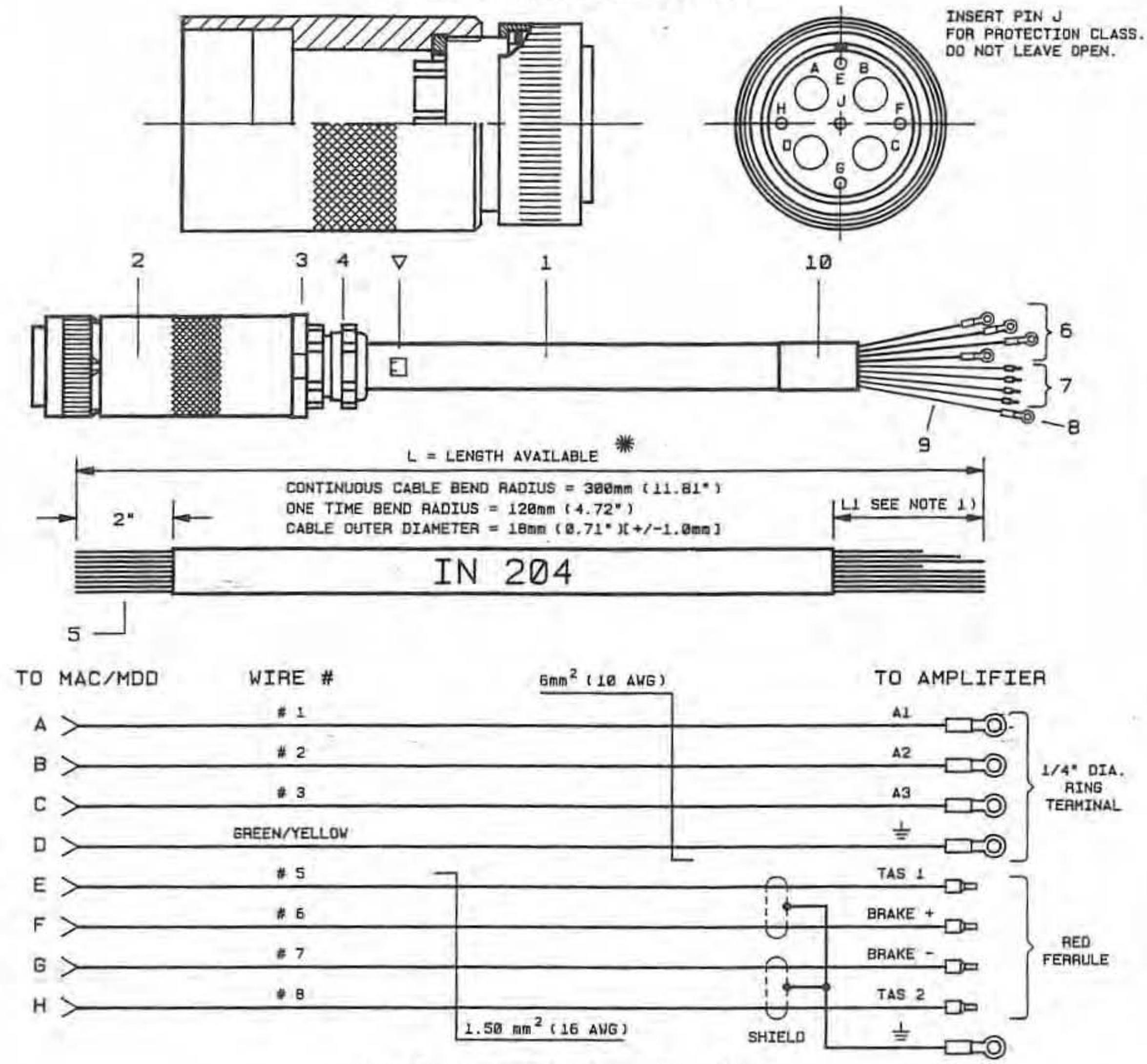
APPENDIX D: CABLE AND CONNECTOR DESCRIPTIONS

CAUTION: *Drawings in this Appendix are included for illustrative purposes only and are subject to change without notice. Check with Indramat to be sure you are working with the latest drawings prior to installing, wiring and powering equipment.*

MAC/MDD-AMPLIFIER 02-0305

DETAIL OF CONNECTOR IN 172



CABLE: 4x6mm² +2x(2x1.50mm²)

NOTES: 1) LENGTH OF CONDUCTORS AS FOLLOWS:

WIRE #1 = 90 mm (3.5")
WIRE #2 = 120 mm (4.75")
WIRE #3 = 150 mm (6")
WIRE GRN/YEL = 90 mm (3.5")
WIRES #5, #6, #7, #8, = 150 mm (6")
SHIELD = 150 mm (6")

✱ MAXIMUM MOTOR POWER CABLE LENGTH IS 75 METERS (246 FEET)

REXROTH INDRAMAT WOOD DALE, IL			MOTOR POWER CABLE MAC/MDD-AMPLIFIER DRAWING NUMBER 209-0070-4801-00/101A						QUALITY DRIVES INDRAMAT	
INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 2
DRAWN BY	D. AVILA	7-22-88	A	SEE PAGE 2	1-18-90	D.P.			REVISION FOR 209-0050-4801-00/101A	
CHECKED BY	D.P.J.	8-31-93	B	REVISED PER E.C.O.	8-25-93	C.M.	930812-01			
ENGINEER APPROVAL	D.P.J.	8-31-93							REVISED BY C. MARTINEZ	

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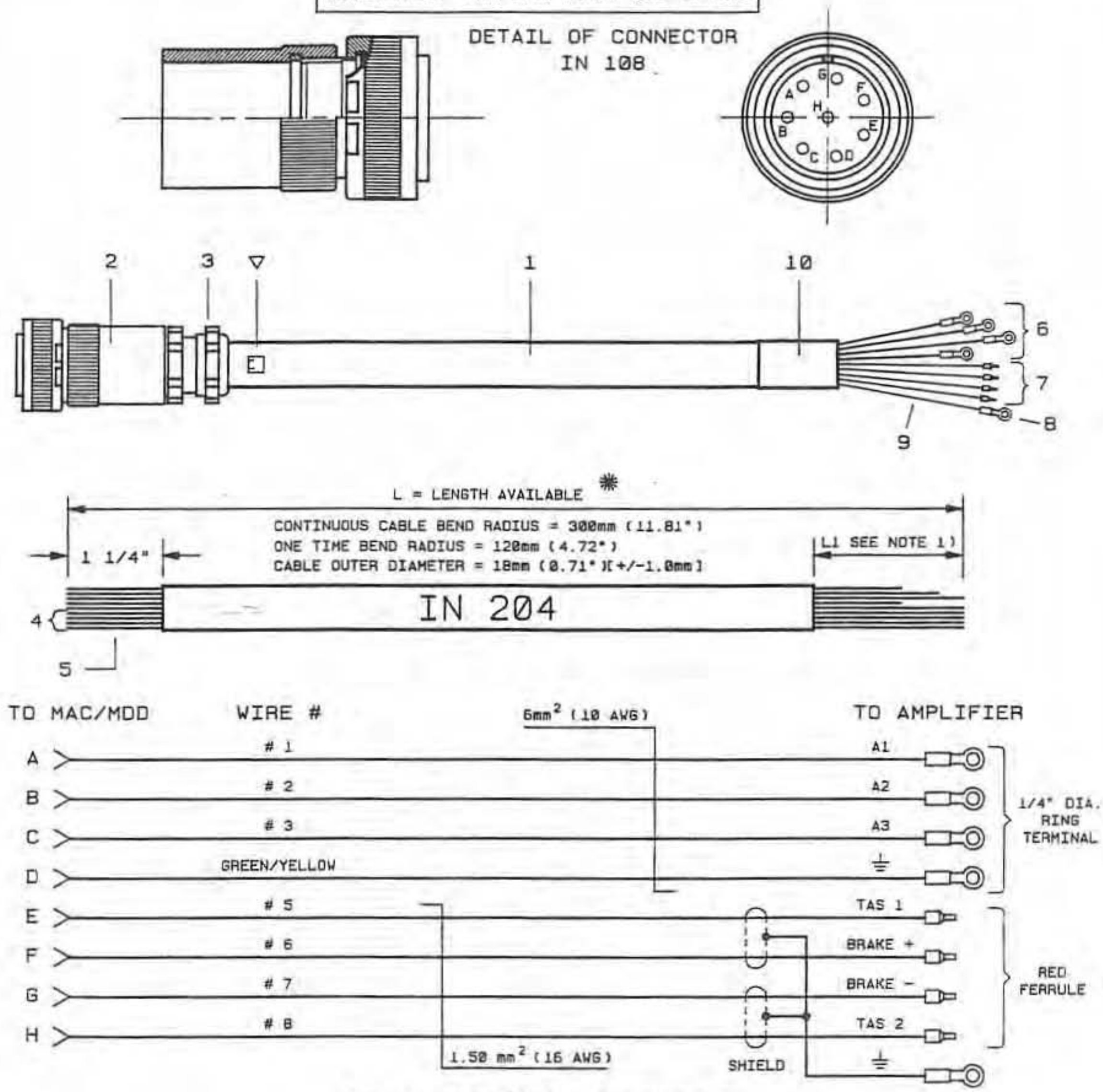
MAC/MDD-AMPLIFIER 02-0400



CABLE: 4x6mm² +2x(2x1.50mm²)

NOTES: 1) LENGTH OF CONDUCTORS AS FOLLOWS:

WIRE #1 = 90 mm (3.5")
WIRE #2 = 120 mm (4.75")
WIRE #3 = 150 mm (6")
WIRE GRN/YEL = 90 mm (3.5")
WIRES #5,#6,#7,#8. = 150 mm (6")
SHIELD = 150 mm (6")

⁕ MAXIMUM MOTOR POWER CABLE LENGTH IS 75 METERS (246 FEET)

REXROTH INDRAMAT WOOD DALE, IL.			MOTOR POWER CABLE MAC/MDD-AMPLIFIER DRAWING NUMBER 209-0070-4801-00/081A						QUALITY DRIVES INDRAMAT
INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S. SHEET 1 OF 2
DRAWN BY	C.MARTINEZ	6-05-90	A	REVISED PER E.C.O.	8-26-93	C.M.	930812-01		REVISION FOR 209-0050-4801-00/081A
CHECKED BY	D. P.J.	8-31-93							REVISED BY C. MARTINEZ
ENGINEER APPROVAL	D. P.J.	8-31-93							

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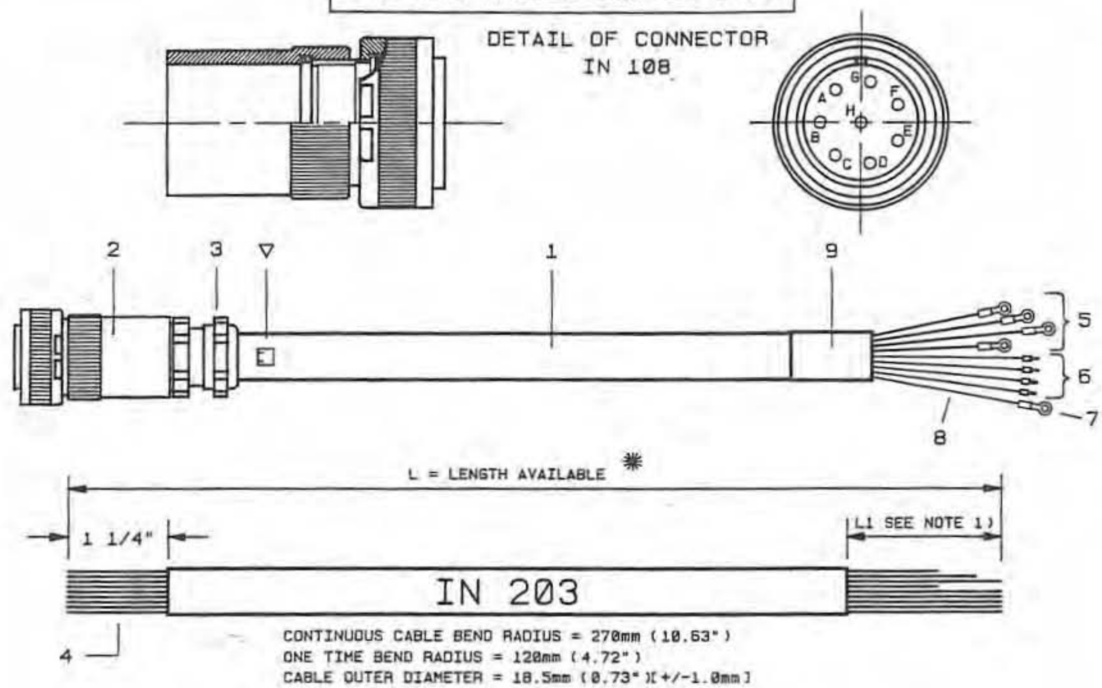
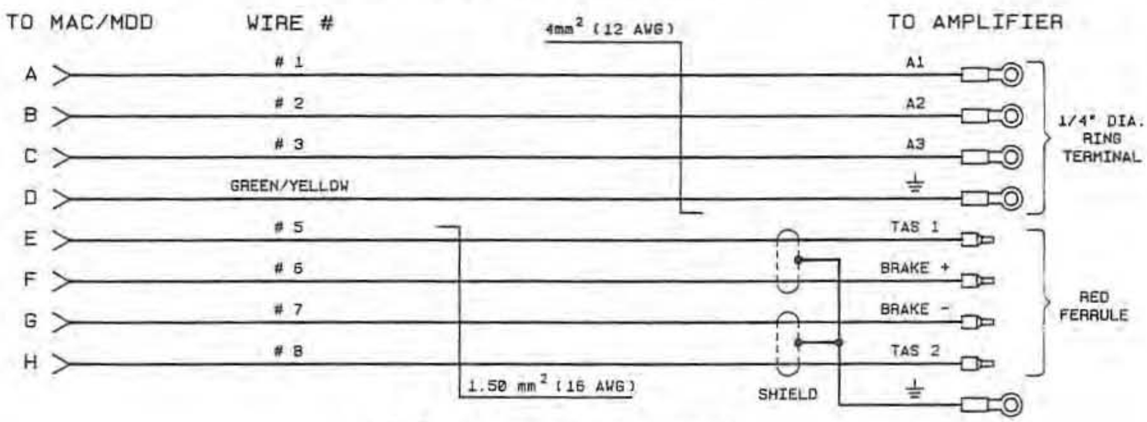
MAC/MDD-AMPLIFIER 02-0410





CABLE: $4\times4mm^2+2\times(2\times1.50mm^2)$

NOTES: 1) LENGTH OF CONDUCTORS AS FOLLOWS:

WIRE #1 = 90 mm (3.5")
WIRE #2 = 120 mm (4.75")
WIRE #3 = 150 mm (6")
WIRE GRN/YEL = 90 mm (3.5")
WIRES #5, #6, #7, #8, = 150 mm (6")
SHIELD = 150 mm (6")

✱ MAXIMUM MOTOR POWER CABLE LENGTH IS 75 METERS (246 FEET)

REXROTH INDRAMAT, WOOD DALE, IL			MOTOR POWER CABLE MAC/MDD-AMPLIFIER						QUALITY DRIVES INDRAMAT
			DRAWING NUMBER 209-0070-4801-00/061A						
INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S. / SHEET 1 OF 2
DRAWN BY	C. MARTINEZ	6-05-90	A	ADDED ITEM #10	12-3-91	D.P.			REVISION FOR 209-0050-4801-00/061A
CHECKED BY	D. P. J.	8-31-93	B	REVISED PER E.C.O.	8-26-93	C.M.	930812-01		REVISED BY C. MARTINEZ
ENGINEER APPROVAL	D. P. J.	8-31-93							

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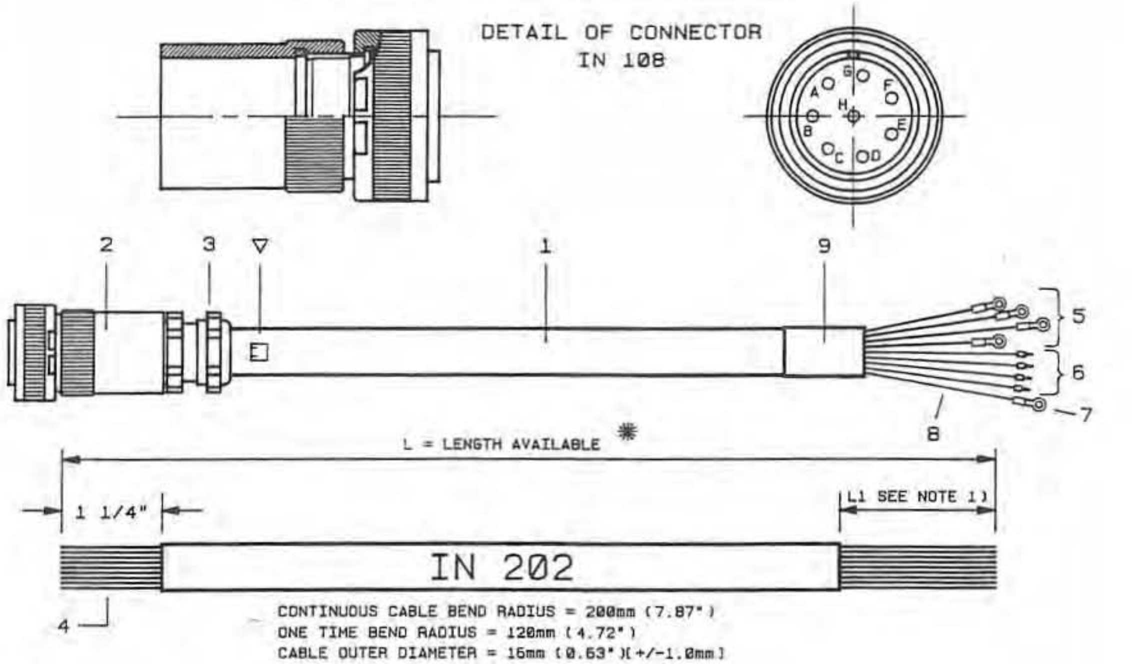
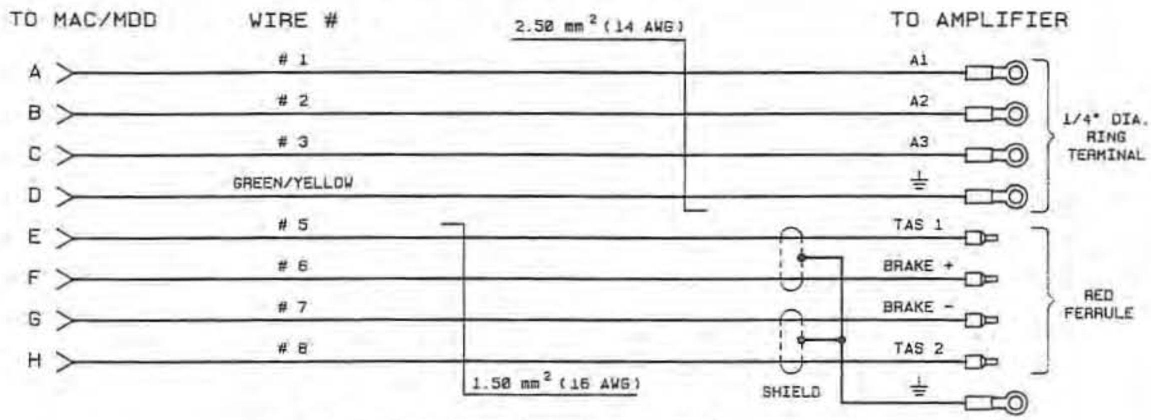
D

MAC/MDD-AMPLIFIER 02-0420





CABLE: 4x2.50mm² +2x(2x1.50mm²)

NOTES: 1) LENGTH OF CONDUCTORS AS FOLLOWS:

WIRE #1 = 90 mm (3.5")	WIRE GRN/YEL = 90 mm (3.5")
WIRE #2 = 120 mm (4.75")	WIRES #5,#6,#7,#8, = 150 mm (6")
WIRE #3 = 150 mm (6")	SHIELD = 150 mm (6")

⁕ MAXIMUM MOTOR POWER CABLE LENGTH IS 75 METERS (246 FEET)

REXROTH INDRAMAT
WOOD DALE, IL.

MOTOR POWER CABLE
MAC/MDD-AMPLIFIER

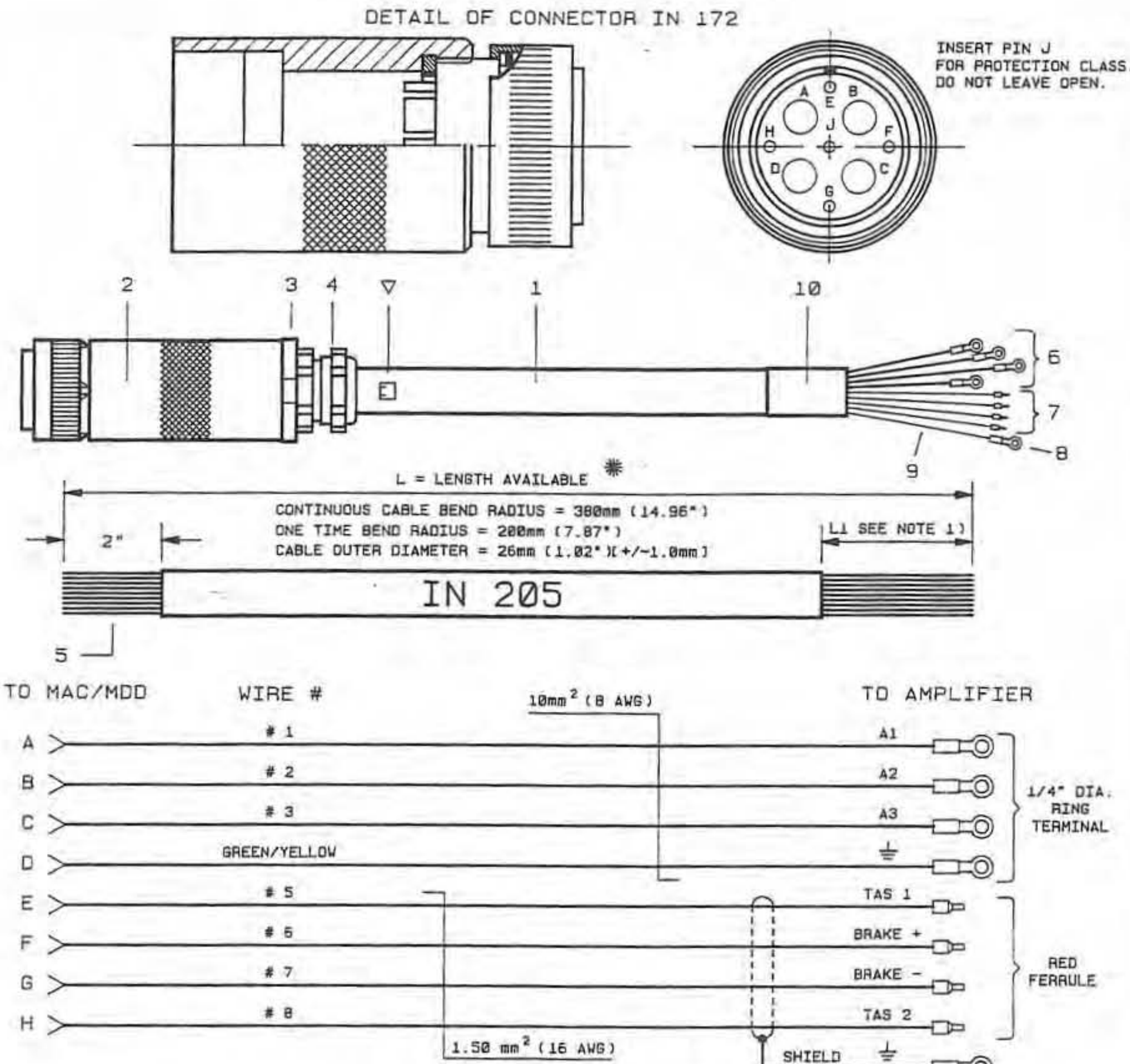
DRAWING NUMBER 209-0070-4801-00/041A

QUALITY DRIVES INDRAMAT

INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 2
DRAWN BY	D. PADILLA	7-28-89	A	REDRAWN WITH CABLE BEND RAD.	5-14-93	D.P.			REVISION FOR 209-0028-4802-00/76A	
			B	SEE PAGE 2	1-18-90	D.P.				
CHECKED BY	D. P. J.	8-31-93	C	REVISED PER E.C.O.	8-26-93	D.P.	930812-01		REVISED BY C.MARTINEZ	
ENGINEER APPROVAL	D. P. J.	8-31-93								

559335

MAC/MDD-AMPLIFIER 02-0430



CABLE: 4x10mm² + (2x2x1.50mm²)

NOTES: 1) LENGTH OF CONDUCTORS AS FOLLOWS:

WIRE #1 = 90 mm (3.5") WIRE GRN/YEL = 90 mm (3.5")
WIRE #2 = 120 mm (4.75") WIRES #5, #6, #7, #8, = 150 mm (6")
WIRE #3 = 150 mm (6") SHIELD = 150 mm (6")

✱ MAXIMUM MOTOR POWER CABLE LENGTH IS 75 METERS (246 FEET)

REXROTH INDRAMAT WOOD DALE, IL.			MOTOR POWER CABLE MAC/MDD-AMPLIFIER						QUALITY DRIVES INDRAMAT
			DRAWING NUMBER 209-0070-4801-00/121A						
INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S. SHEET 1 OF 2
DRAWN BY	C.MARTINEZ	6-05-90	A	REVISED PER E.C.O.	8-26-93	C.M.	930812-01		REVISION FOR 209-0050-4801-00/121A
CHECKED BY	D.P.J.	8-31-93							REVISED BY C.MARTINEZ
ENGINEER APPROVAL	D.P.J.	8-31-93							

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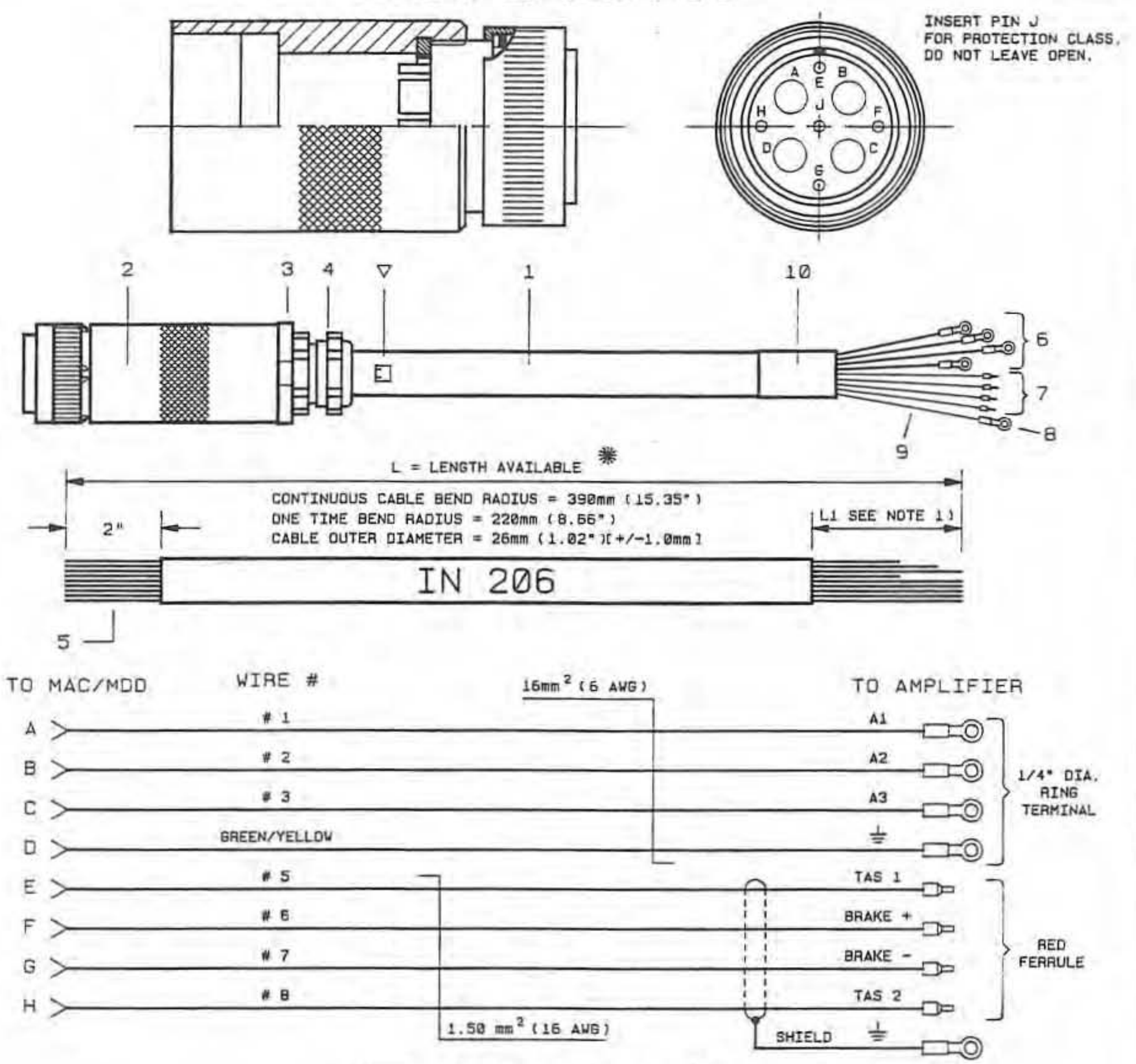
D

MAC/MDD-AMPLIFIER 02-0440

DETAIL OF CONNECTOR IN 172



CABLE: $4 \times 16mm^2 + (2 \times 2 \times 1.50mm^2)$

NOTES: 1) LENGTH OF CONDUCTORS AS FOLLOWS:

WIRE #1 = 90 mm (3.5")
WIRE #2 = 120 mm (4.75")
WIRE #3 = 150 mm (6")
WIRE GRN/YEL = 90 mm (3.5")
WIRES #5, #6, #7, #8, = 150 mm (6")
SHIELD = 150 mm (6")

❋ MAXIMUM MOTOR POWER CABLE LENGTH IS 75 METERS (246 FEET)

REXROTH INDRAMAT
WOOD DALE, IL

MOTOR POWER CABLE
MAC/MDD-AMPLIFIER

DRAWING NUMBER 209-0070-4801-00/141A

QUALITY DRIVES INDRAMAT

INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 2
DRAWN BY	C.MARTINEZ	6-06-90	A	REVISED PER E.C.O.	11-30-92	D.P.	920924-02		REVISION FOR 209-0050-4801-00/141A	
			B	REVISED PER E.C.O.	8-26-93	C.M.	930812-01			
CHECKED BY	D.R.J.	8-31-93							REVISED BY C. MARTINEZ	
ENGINEER APPROVAL	D.R.J.	8-31-93								

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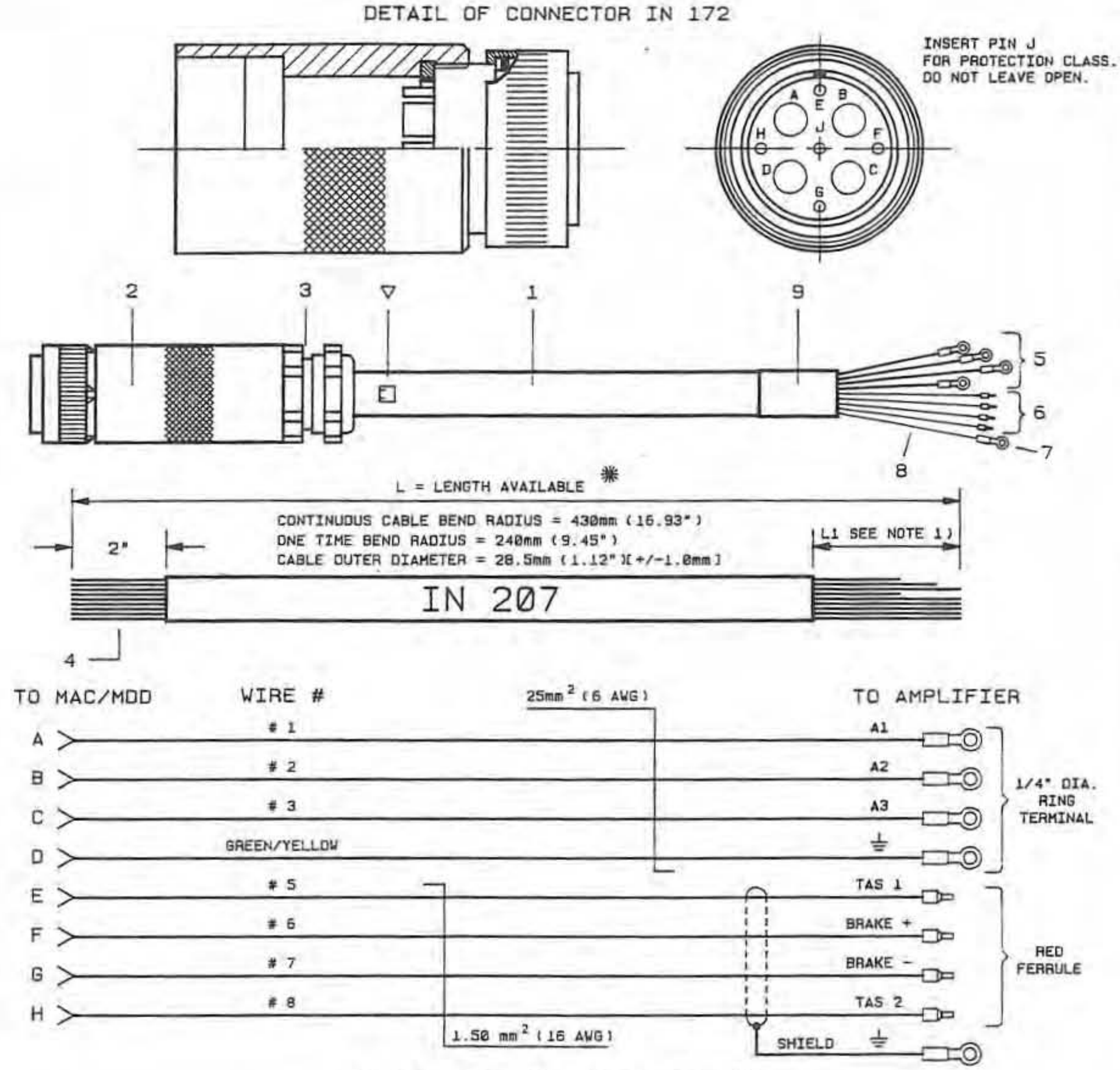
MAC/MDD-AMPLIFIER 02-0450



CABLE: 4x25mm² + 2x(2x1.50mm²)

NOTES: 1) LENGTH OF CONDUCTORS AS FOLLOWS:

WIRE #1 = 90 mm (3.5")
WIRE #2 = 120 mm (4.75")
WIRE #3 = 150 mm (6")
WIRE GRN/YEL = 90 mm (3.5")
WIRES #5,#6,#7,#8, = 150 mm (6")
SHIELD = 150 mm (6")

✱ MAXIMUM MOTOR POWER CABLE LENGTH IS 75 METERS (246 FEET)

REXROTH INDRAMAT
WOOD DALE, IL.

MOTOR POWER CABLE
MAC/MDD-AMPLIFIER

DRAWING NUMBER 209-0070-4801-00/161A

QUALITY DRIVES INDRAMAT

INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 2
DRAWN BY	D. PADILLA	8-17-93	A	ADDED CABLE INFO.	1-18-92	D.P.			REVISION FOR 209-0050-4801-00/161A	
			B	REVISED PER E.C.O.	8-26-93	C.M.	930812-01			
CHECKED BY	D.P.J.	8-31-93							REVISED BY C.MARTINEZ	
ENGINEER APPROVAL	D.P.J.	8-31-93								

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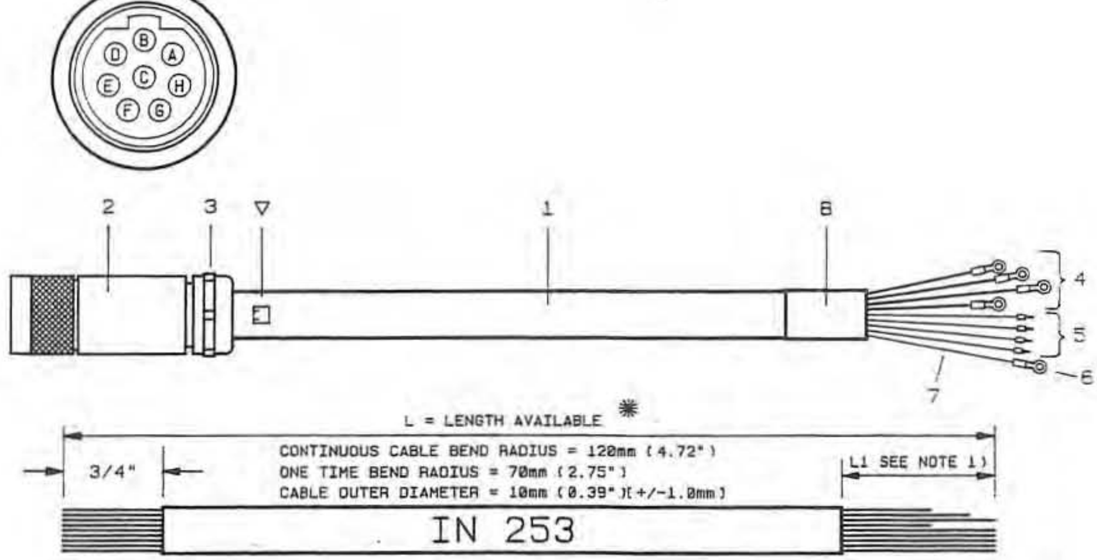
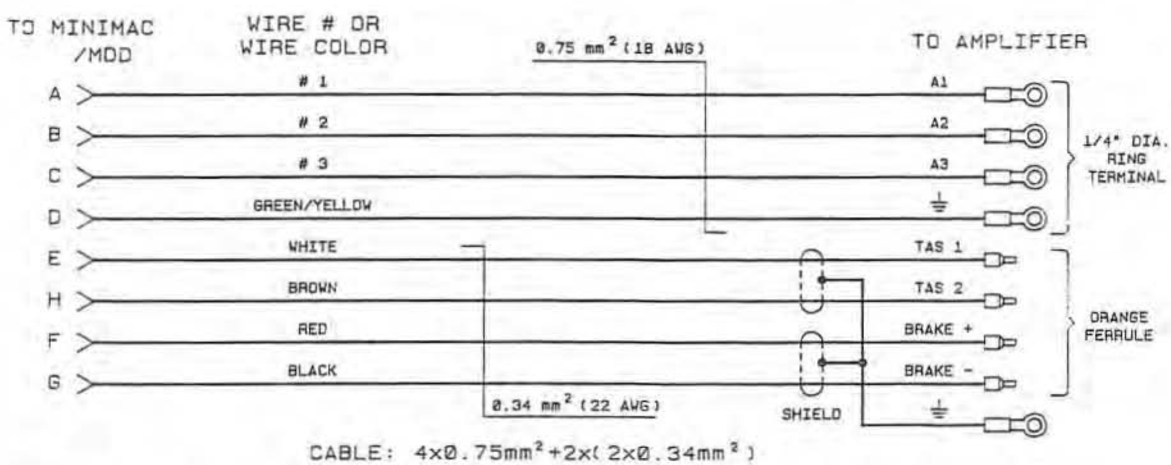
D

MINIMAC/MDD-AMPLIFIER 02-0460

DETAIL OF CONNECTOR IN 252/S01





CABLE: 4x0.75mm²+2x(2x0.34mm²)

NOTES: 1) LENGTH OF CONDUCTORS AS FOLLOWS:

WIRE #1 = 90 mm (3.5")
WIRE #2 = 120 mm (4.75")
WIRE #3 = 150 mm (6")
WIRE GRN/YEL = 90 mm (3.5")
WIRES #5,#6,#7,#8, = 150 mm (6")
SHIELD = 150 mm (6")

✱ MAXIMUM MOTOR POWER CABLE LENGTH IS 75 METERS (246 FEET)

REXROTH INDRAMAT
WOOD DALE, IL.

MOTOR POWER CABLE
MINIMAC/MDD-AMPLIFIER

DRAWING NUMBER 209-0070-4801-00/001A

QUALITY DRIVES INDRAMAT

INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 2
DRAWN BY	C.MARTINEZ	6-06-90	A	CHANGED CONNECTOR STYLE	2-9-92	D.P.			REVISION FOR	
				AND ADDED CABLE INF.					209-0050-4801-00/001A	
CHECKED BY	D.P.T.	8-31-93	B	REVISED PER E.C.O.	12-1-92	D.P.	920924-02		REVISED BY	
ENGINEER APPROVAL	D.P.T.	8-31-93	C	REVISED PER E.C.O.	8-26-93	C.M.	930812-01		C. MARTINEZ	

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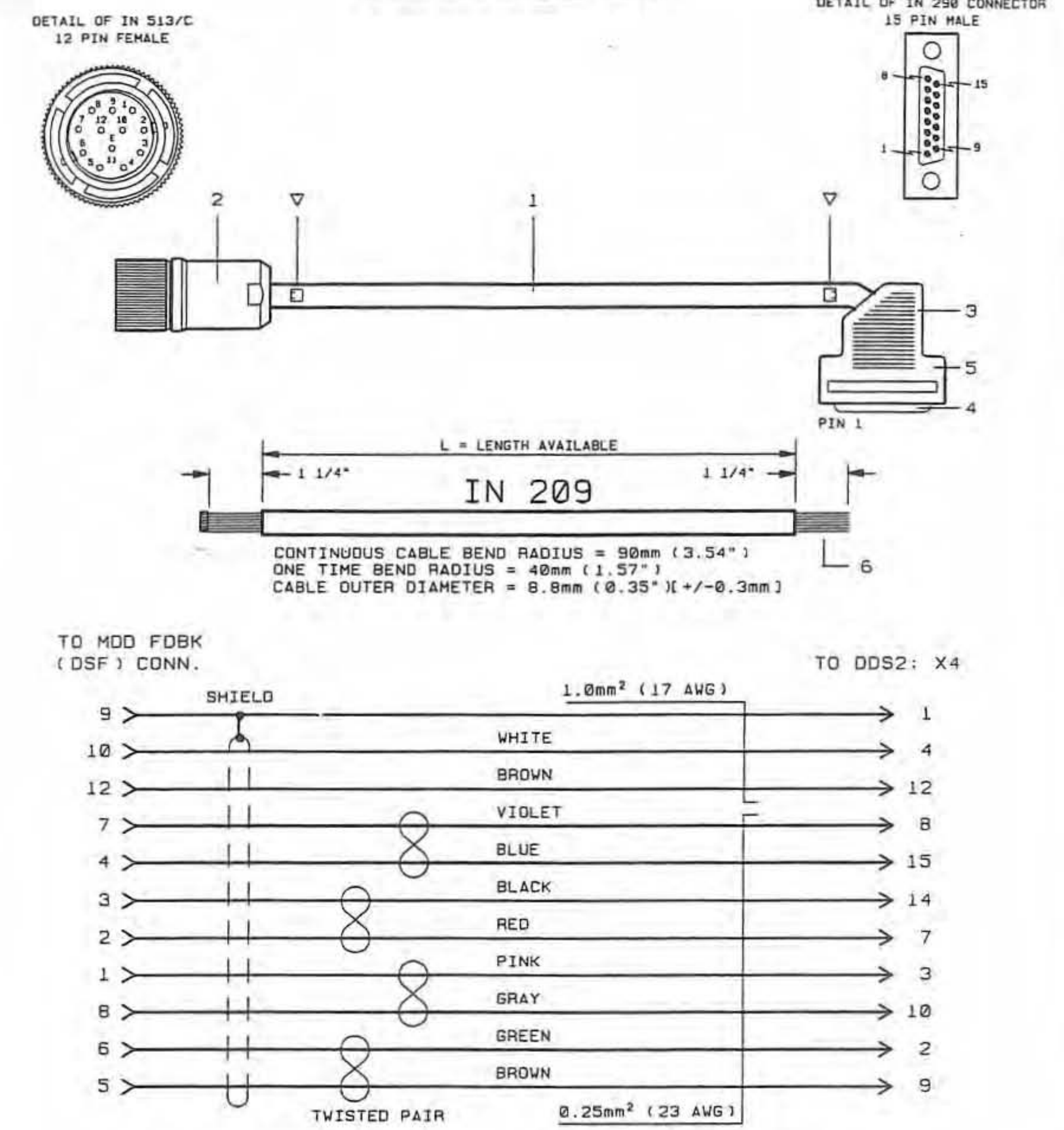
MDD-DDS 03-0374



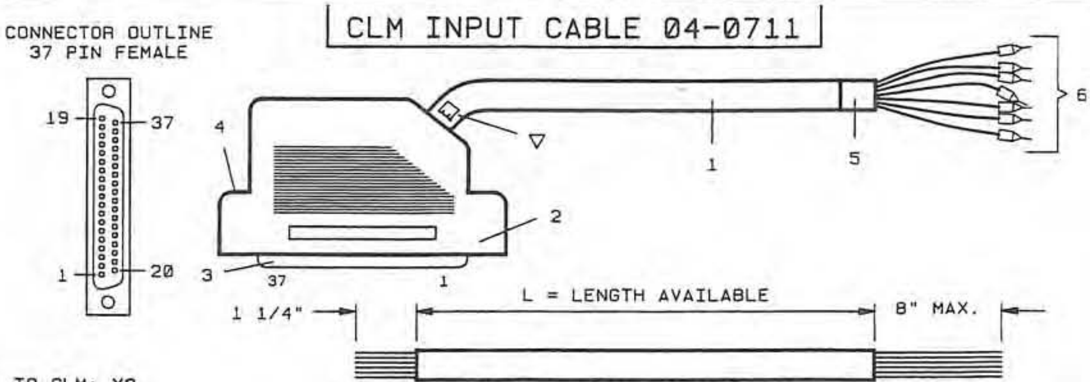
CABLE: 4x2x0.25mm² + 2x1.0mm²

* MAXIMUM DIGITAL FEEDBACK LENGTH IS 75 METERS (246 FEET)

REXROTH INDRAMAT WOOD DALE, IL.	DIGITAL SERVO FEEDBACK CABLE MDD - DDS 2.X						QUALITY DRIVES INDRAMAT	
	DRAWING NUMBER 209-0050-4801-00/374A							

INFO.	NAME	DATE	REV.	DESCRIPTION	DATE	NAME	E.C.O. NUMBER	PART NUMBER	SCALE N.T.S.	SHEET 1 OF 2
DRAWN BY	D. PADILLA	1-13-92	A	REVISED PER E.C.O.	8/92	D.P.	920828-01		REVISION FOR	
CHECKED BY	D.P.J.	1-31-94	B	REVISED PER E.C.O.	2-15-93	D.P.	930215-01			
			C	REVISED PER E.C.O.	1-28-94	D.P.	940119-01		REVISED BY	
ENGINEER APPROVAL	D.P.J.	1-31-94								

CLM INPUT CABLE 04-0711



CONTINUOUS CABLE BEND RADIUS = 125mm (4.921")
ONE TIME BEND RADIUS = 60mm (2.362")

TO CLM: X3 : X11 : X12

TO TERMINAL STRIP — ORANGE FERRULES

1	GREEN/BLACK
2	GRAY/PINK
3	GREEN/RED
4	YELLOW/BLACK
5	GREEN/BLUE
6	RED/BLUE
7	YELLOW/BROWN
8	GRAY/BROWN
9	WHITE/RED
10	WHITE/PINK
11	WHITE/BLACK
12	PINK/BROWN
13	WHITE/YELLOW
14	WHITE/GREEN
15	WHITE/BLUE
16	GRAY/GREEN
17	WHITE/GRAY
18	WHITE
19	VIOLET
20	YELLOW
21	PINK
22	BLUE
23	YELLOW/GRAY
24	PINK/GREEN
25	YELLOW/PINK
26	BROWN/BLUE
27	BROWN/GREEN
28	YELLOW/BLUE
29	YELLOW/RED
30	BROWN/RED
31	BROWN/BLACK
32	BROWN
34	BLACK
35	GRAY
36	RED
37	GREEN
	SHIELD

REXROTH INDRAMAT
CHICAGO ILL.

CLM SOFTWARE INPUT CABLE

DRAWING NUMBER	209-0050-4801-00/711A		
DRAWN BY 1-9-98 D. PADILLA	APPROVED BY (signature)	SCALE N.T.S.	REVISION FOR / REVISED BY	SHEET 1 OF 2

Rev.	Description	Date	Init.

529934

APPENDIX E: ORDERING TYPE CODES

CAUTION: *Drawings in this Appendix are included for illustrative purposes only and are subject to change without notice. Check with Indramat to be sure you are working with the latest drawings prior to installing, wiring and powering equipment.*

DDS 2.1 Type Code

DDS 2.1 - W100 - DS 01

Drive Type

Version Number

Cooling Type
- **Warm Type = W**
- **Forced Air Type = K**
- **Fluid Cooled = F**

Rated Current

Configuration Type
- **DS = SERCOS w/DSF Feedback**
- **DA= Analog w/ DSF Feedback**
- **RS = SERCOS w/Resolver Feedback**
- **RA= Analog w/ Resolver Feedback**

Configuration Number

Corresponds to configuration drawings

DDS 2.1 Option Card Type Code

DAE 1.1

Card Type (See below) — DAE

Version Number — 1.1

Card Types

DAA 1.1 - Analog Interface Card w/Absolute Encoder Emulator
DAE 1.1 - Analog Interface Card w/ Incremental Encoder Emulator
DSS 1.1 - SERCOS Interface Card
DEF 1.1 - External Digital Encoder Input Card
DEF 2.1 - Second External Digital Encoder Input Card
DLF 1.1 - External Analog (Linear) Feedback Input Card
DEA 4.1 - Digital I/O Card
DEA 5.1 - Second Digital I/O Card
DEA 6.1 - Third Digital I/O Card

MDD021 Type Code

MDD021B - N - 100 - N2G - 032GB0 / S00

Motor Type

Frame Size

Motor Length
A, B

Power Connector Size
Normal = N

Nominal Speed
10,000 rpm = 100

Balancing
Normal (Standard) = N
Reduced Vibration = R

Motor Structure
Without Stubshaft (Standard) = 2
With Stubshaft = 5

Feedback Type
Resolver Feedback (Standard) = G
Resolver with Absolute Function Feedback = K

Pilot Diameter
032 mm = 032

Shaft Configuration
Smooth Shaft = G
Keyway = P

Power Connector
A side = A
B side = B

Brake
Without Brake = 0

Special Options

MDD025 Type Code

MDD025B - N - 100 - N2G - 040GB0 / S00

Motor Type

Frame Size

Motor Length
A, B, C

Power Connector Size
Normal = N

Nominal Speed
10,000 rpm = 100

Balancing
Normal (Standard) = N
Reduced Vibration = R

Motor Structure
Without Stubshaft (Standard) = 2
With Stubshaft = 5

Feedback Type
Resolver Feedback (Standard) = G
Resolver with Absolute Function Feedback = K

Pilot Diameter
040 mm = 040

Shaft Configuration
Smooth Shaft = G
Keyway = P

Power Connector
A side = A
B side = B
Left Side (Looking at the motor shaft) = L
Right Side (Looking at the motor shaft) = R

Brake
Without Brake = 0
With 1.0 NM Brake = 1

Special Options

MDD041 Type Code

MDD041B - N - 100 - N2G - 050GB0 / S00

Motor Type

Frame Size

Motor Length
A, B, C

Power Connector Size
Normal = N

Nominal Speed
10,000 rpm = 100

Balancing
Normal (Standard) = N
Reduced Vibration = R

Motor Structure
Without Stubshaft (Standard) = 2
With Stubshaft = 5

Feedback Type
Resolver Feedback (Standard) = G
Resolver with Absolute Function Feedback = K

Pilot Diameter
050 mm = 050

Shaft Configuration
Smooth Shaft = G
Keyway = P

Power Connector
A side = A
B side = B
Left Side (Looking at the motor shaft) = L
Right Side (Looking at the motor shaft) = R

Brake
Without Brake = 0
With 1.0 NM Brake = 1

Special Options

MDD065 Type Code

MDD065B - N - 040 - N2L - 095GB0 / S00

- **Motor Type** — MDD
- **Frame Size** — 065
- **Motor Length** — B
  - A, B, C, D
- **Power Connector Size** — N
  - Normal = N
- **Nominal Speed** — 040
  - 4000 rpm = 040
  - 6000 rpm = 060
- **Balancing** — N
  - Normal (Standard) = N
  - Reduced Vibration = R
- **Motor Structure** — 2
  - Without Stubshaft (Standard) = 2
  - With Stubshaft = 5
- **Feedback Type** — L
  - DSF (Standard) = L
  - Multiturn Absolute = M
- **Pilot Diameter** — 095
  - 095 mm = 095
- **Shaft Configuration** — G
  - Smooth Shaft = G
  - Keyway = P
- **Power Connector** — B
  - A side = A
  - B side = B
  - Left Side (Looking at the motor shaft) = L
  - Right Side (Looking at the motor shaft) = R
- **Brake** — 0
  - Without Brake = 0
  - With 3.0 NM Brake = 1
- **Special Options** — S00

MDD071 Type Code

MDD071B - N - 030 - N2L - 095GB0 / S00

Motor Type

Frame Size

Motor Length
- A, B, C

Power Connector Size
- Normal = N

Nominal Speed
- 3000 rpm = 030
- 4000 rpm = 040
- 6000 rpm = 060

Balancing
- Normal (Standard) = N
- Reduced Vibration = R

Motor Structure
- Without Stubshaft (Standard) = 2
- With Stubshaft = 5

Feedback Type
- DSF (Standard) = L
- Multiturn Absolute = M

Pilot Diameter
- 095 mm = 095

Shaft Configuration
- Smooth Shaft = G
- Keyway = P

Power Connector
- A side = A
- B side = B
- Left Side (Looking at the motor shaft) = L
- Right Side (Looking at the motor shaft) = R

Brake
- Without Brake = 0
- With 3.0 NM Brake = 1
- With 6.5 NM Brake = 2

Special Options

MDD090 Type Code

MDD090B - N - 020 - N2L - 110GB0 / S00

Motor Type

Frame Size

Motor Length
A, B, C

Power Connector Size
Normal = N

Nominal Speed
2000 rpm = 020
3000 rpm = 030
4000 rpm = 040

Balancing
Normal (Standard) = N
Reduced Vibration = R

Motor Structure
Without Stubshaft (Standard) = 2
With Stubshaft = 5

Feedback Type
DSF (Standard) = L
Multiturn Absolute = M

Pilot Diameter
110 mm (Standard) = 110
130 mm = 130

Shaft Configuration
Smooth Shaft = G
Keyway = P

Power Connector
A side = A
B side = B
Left Side (Looking at the motor shaft) = L
Right Side (Looking at the motor shaft) = R

Brake
Without Brake = 0
With 6.5 NM Brake = 1
With 11.0 NM Brake = 2

Special Options

MDD093 Type Code

MDD093B - N - 020 - N2L - 110GB0 / S00

Motor Type

Frame Size

Motor Length
- A, B, C

Power Connector Size
- Normal = N
- Large = L

Nominal Speed
- 2000 rpm = 020
- 3000 rpm = 030
- 4000 rpm = 040
- 6000 rpm = 060

Balancing
- Normal (Standard) = N
- Reduced Vibration = R

Motor Structure
- Without Stubshaft (Standard) = 2
- With Stubshaft = 5

Feedback Type
- DSF (Standard) = L
- Multiturn Absolute = M

Pilot Diameter
- 110 mm (Standard) = 110
- 130 mm = 130

Shaft Configuration
- Smooth Shaft = G
- Keyway = P

Power Connector
- A side = A
- B side = B
- Left Side (Looking at the motor shaft) = L
- Right Side (Looking at the motor shaft) = R

Brake
- Without Brake = 0
- With 11.0 NM Brake = 1
- With 22.0 NM Brake = 2

Special Options

MDD095 Type Code

MDD095B - N - 030 - N2L - 110GB0 / S00

Motor Type — MDD
Frame Size — 095
Motor Length — B
A, B, C

Power Connector Size — N
Normal = N

Nominal Speed — 030
3000 rpm = 030
4000 rpm = 040
6000 rpm = 060

Balancing — N
Normal (Standard) = N
Reduced Vibration = R

Motor Structure — 2
Without Stubshaft (Standard) = 2
With Stubshaft = 5

Feedback Type — L
DSF (Standard) = L
Multiturn Absolute = M

Pilot Diameter — 110
110 mm (Standard) = 110
130 mm = 130

Shaft Configuration — G
Smooth Shaft = G
Keyway = P

Power Connector — B
A side = A
B side = B
Left Side (Looking at the motor shaft) = L
Right Side (Looking at the motor shaft) = R

Brake — 0
Without Brake = 0
With 6.5 NM Brake = 1
With 11.0 NM Brake = 2

Special Options — S00

MDD112 Type Code

MDD112B - N - 015 - N2L - 130PB0 / S00

Motor Type

Frame Size

Motor Length
A, B, C, D

Power Connector Size
Normal = N
Large = L

Nominal Speed
1500 rpm = 015
2000 rpm = 020
3000 rpm = 030
4000 rpm = 040

Balancing
Normal (Standard) = N
Reduced Vibration = R

Motor Structure
Without Stubshaft (Standard) = 2
With Stubshaft = 5

Feedback Type
DSF (Standard) = L
Multiturn Absolute = M

Pilot Diameter
130 mm (Standard) = 130
180 mm = 180

Shaft Configuration
Smooth Shaft = G
Keyway = P

Power Connector
A side = A
B side = B
Left Side (Looking at the motor shaft) = L
Right Side (Looking at the motor shaft) = R

Brake
Without Brake = 0
With 14 NM Brake = 1
With 40 NM Brake = 2
With 60 NM Brake = 2

Special Options

MDD115 Type Code

MDD115B - N - 015 - N2L - 130GB0 / S00

Motor Type

Frame Size

Motor Length
A, B, C, D

Power Connector Size
Normal = N
Large = L

Nominal Speed
1500 rpm = 015
2000 rpm = 020
3000 rpm = 030

Balancing
Normal (Standard) = N
Reduced Vibration = R

Motor Structure
Without Stubshaft (Standard) = 2
With Stubshaft = 5

Feedback Type
DSF (Standard) = L
Multiturn Absolute = M

Pilot Diameter
130 mm (Standard) = 130
180 mm = 180

Shaft Configuration
Smooth Shaft = G
Keyway = P

Power Connector
A side = A
B side = B
Left Side (Looking at the motor shaft) = L
Right Side (Looking at the motor shaft) = R

Brake
Without Brake = 0
With 45.0 NM Brake = 1
With 60.0 NM Brake = 2

Special Options

MDD117 Type Code

MDD117B - N - 020 - N2L - 130GB0 / S00

Motor Type

Frame Size

Motor Length
- A, B, C, D

Power Connector Size
- Normal = N

Nominal Speed
- 2000 rpm = 020
- 3000 rpm = 030
- 4000 rpm = 040
- 6000 rpm = 060

Balancing
- Normal (Standard) = N
- Reduced Vibration = R

Motor Structure
- Without Stubshaft (Standard) = 2
- With Stubshaft = 5

Feedback Type
- DSF (Standard) = L
- Multiturn Absolute = M

Pilot Diameter
- 130 mm (Standard) = 130
- 180 mm = 180

Shaft Configuration
- Smooth Shaft = G
- Keyway = P

Power Connector
- A side = A
- B side = B
- Left Side (Looking at the motor shaft) = L
- Right Side (Looking at the motor shaft) = R

Brake
- Without Brake = 0
- With 14.0 NM Brake = 1
- With 22.0 NM Brake = 2

Special Options

APPENDIX F: SERCOS REFERENCE

SERCOS Parameters of DDS 2.1 Software Version S01.09

S-0-0001 Control Unit Cycle Time, (t_{Ncyc})
S-0-0002 SERCOS Cycle Time, (t_{Scyc})
S-0-0003 Minimum AT Transmit Starting Time, (t_{1min})
S-0-0004 Transmit to Receive Transition Time, (t_{ATMT})
S-0-0005 Minimum Feedback Acquisition Time, (t_5)
S-0-0006 AT Transmission Starting Time, (t_1)
S-0-0007 Feedback Acquisition Starting Time, (t_4)
S-0-0008 Command Valid Time, (t_3)
S-0-0009 Beginning Address in MDT
S-0-0010 Length of the MDT
S-0-0011 Class 1 Diagnostics
S-0-0012 Class 2 Diagnostics
S-0-0013 Class 3 Diagnostics
S-0-0014 Interface Status
S-0-0015 Telegram Type Parameter
S-0-0016 Custom AT Configuration List
S-0-0017 ID Number List of All Operation Data
S-0-0021 List of Invalid ID Numbers for Communication Phase 2
S-0-0022 List of Invalid ID Numbers for Communication Phase 3
S-0-0024 Custom MDT Configuration List
S-0-0028 MST Error Counter
S-0-0029 MDT Error Counter
S-0-0030 Manufacturer Version
S-0-0032 Primary Operation Mode
S-0-0033 Secondary Operation Mode - 1
S-0-0034 Secondary Operation Mode - 2
S-0-0035 Secondary Operation Mode - 3
S-0-0036 Velocity Command Value
S-0-0040 Velocity Feedback Value
S-0-0041 Homing Velocity
S-0-0042 Homing Acceleration
S-0-0043 Velocity Polarity Parameter
S-0-0044 Velocity Data Scaling Method
S-0-0045 Linear Velocity Data Scaling Factor
S-0-0046 Linear Velocity Data Scaling Exponent
S-0-0047 Position Command Value
S-0-0049 Positive Position Limit Value
S-0-0050 Negative Position Limit Value
S-0-0051 Position Feedback Value 1, (Motor Encoder)
S-0-0052 Position Feedback 1 - Reference Distance
S-0-0053 Position Feedback Value 2, (External Feedback)
S-0-0054 Position Feedback 2 - Reference Distance
S-0-0055 Position Polarity Parameter
S-0-0057 In Position Window
S-0-0076 Scaling Options for Position Data
S-0-0077 Linear Position Data Scaling Factor
S-0-0078 Linear Position Data Scaling Exponent
S-0-0079 Rotational Position Resolution
S-0-0080 Torque Command Value
S-0-0084 Torque Feedback Value
S-0-0085 Torque Polarity Parameter
S-0-0086 Scaling Options for Torque - Force Data
S-0-0088 Receive to Receive Recovery Time, (t_{MTSY})
S-0-0089 MDT Transmit Starting Time, (t_2)
S-0-0090 Command Value Transmit Time, (t_{MTSG})
S-0-0091 Bipolar Velocity Limit Value
S-0-0092 Bipolar Torque Limit Value
S-0-0093 Scaling Factor for Torque-Force Data
S-0-0094 Scaling Exponent for Torque-Force Data
S-0-0095 Diagnostic Message
S-0-0096 Slave Arrangement, (SLKN)
S-0-0099 Reset Class 1 Diagnostics
S-0-0100 Velocity Loop Proportional Gain
S-0-0101 Velocity Loop Integral Reaction Time
S-0-0103 Modulo Value
S-0-0104 Position Loop Gain, (KV Factor)
S-0-0106 Current Loop Proportional Gain 1
S-0-0108 Feedrate Override
S-0-0109 Motor Peak Current
S-0-0110 Amplifier Peak Current
S-0-0111 Continuous Motor Current
S-0-0112 Amplifier Continuous Current
S-0-0113 Maximum Motor Velocity
S-0-0115 Position Feedback Type Parameter
S-0-0117 Resolution of Rotational Feedback 2, (External Feedback)
S-0-0118 Resolution of Linear Feedback 2, (External Feedback)
S-0-0121 Input Revolutions of Load Gear
S-0-0122 Output Revolutions of Load Gear
S-0-0123 Feed Constant
S-0-0124 Zero Velocity Window
S-0-0127 Communication Phase 3 Transition Check
S-0-0128 Communication Phase 4 Transition Check
S-0-0130 Probe 1 - Positive Edge Position Value
S-0-0131 Probe 1 - Negative Edge Position Value
S-0-0132 Probe 2 - Positive Edge Position Value
S-0-0133 Probe 2 - Negative Edge Position Value
S-0-0134 Master Control Word
S-0-0135 Drive Status Word
S-0-0138 Bipolar Acceleration
S-0-0140 Drive Type
S-0-0141 Motor Type
S-0-0142 Application Type
S-0-0143 SERCOS Interface Version
S-0-0147 Homing Parameter
S-0-0148 Drive Controlled Homing Procedure Command
S-0-0149 Drive Into Positive Stop Procedure Command
S-0-0150 Reference Offset 1
S-0-0151 Reference Offset 2
S-0-0155 Friction Torque Compensation
S-0-0159 Monitoring Window
S-0-0160 Scaling Options for Acceleration Data
S-0-0161 Scaling Factor for Acceleration Data
S-0-0162 Scaling Exponent for Acceleration Data
S-0-0165 Distance Coded Scale 1
S-0-0166 Distance Coded Scale 2
S-0-0169 Probe Control Parameter
S-0-0170 Probing Cycle Procedure Command
S-0-0173 Marker Position A
S-0-0177 Absolute Dimension Offset 1
S-0-0178 Absolute Dimension Offset 2
S-0-0182 Manufacturer Class 3 Diagnostics
S-0-0185 Length of Configurable Data Record of the AT
S-0-0186 Length of Configurable Data Record of the MDT
S-0-0187 List of Configurable Data of the AT
S-0-0188 List of Configurable Data of the MDT
S-0-0189 Following Error
S-0-0192 List of Backup Operation Data
S-0-0262 Load Default Gain Parameters - Procedure Command
S-0-0301 Allocation of Real Time Control Bit 1
S-0-0303 Allocation of Real Time Control Bit 2
S-0-0305 Allocation of Real Time Status Bit 1
S-0-0307 Allocation of Real Time Status Bit 2
S-0-0400 Home Switch
S-0-0401 Probe 1
S-0-0402 Probe 2
S-0-0403 Position Feedback Status

S-0-0405 Probe 1 Enable
S-0-0406 Probe 2 Enable
S-0-0409 Probe 1 Positive Edge Latched
S-0-0410 Probe 1 Negative Edge Latched
S-0-0411 Probe 2 Positive Edge Latched
S-0-0412 Probe 2 Negative Edge Latched

List of the product specific parameters in the DDS 2.1

P-0-0004 Smoothing Time Constant
P-0-0005 Language Selection
P-0-0006 Overload Factor
P-0-0007 Error Reaction
P-0-0010 Excessive Position Command Value
P-0-0011 Last Valid Position Command Value
P-0-0012 Set Absolute Measuring Procedure Command
P-0-0014 Determine Marker Position - Procedure Command
P-0-0019 Starting Position Value
P-0-0020 Displacement of the Home Switch
P-0-0021 Oscilloscope Channel 1 - Acquired Data Samples
P-0-0022 Oscilloscope Channel 2 - Acquired Data Samples
P-0-0023 Signal Selection - Channel 1
P-0-0024 Signal Selection - Channel 2
P-0-0025 Trigger Source
P-0-0026 Trigger Signal Selection
P-0-0027 Trigger Threshold for Position Data
P-0-0028 Trigger Threshold for Velocity Data
P-0-0029 Trigger Threshold for Torque Data
P-0-0030 Trigger Mode
P-0-0031 Time Divisions
P-0-0032 Memory Allocation
P-0-0033 Number of Samples After the Start of the Recording
P-0-0035 Trigger Offset
P-0-0036 Trigger Control Word
P-0-0037 Trigger Status Word
P-0-0038 Signal Selection of the Analog Monitor Output - Channel 1
P-0-0039 Signal Selection for Analog Monitor Output - Channel 2
P-0-0040 Scaling of Velocity Data on the Analog Monitor Output - Chan. 1
P-0-0041 Scaling of Velocity Data on the Analog Monitor Output - Chan. 2
P-0-0042 Scaling of Position Data on the Analog Monitor Output - Chan. 1
P-0-0043 Scaling of Position Data on the Analog Monitor Output - Chan. 2
P-0-0045 IDN List of Control Dependent Application Parameters
P-0-0046 IDN List of Machine Dependent Application Parameters
P-0-0047 IDN List of Drive Parameters
P-0-0048 IDN List of Gain Adjustment Parameters
P-0-0049 Target Position
P-0-0050 Proportional Gain Acceleration Feed Forward
P-0-0051 Torque Constant
P-0-0055 Status of Feed Error Compensation
P-0-0056 Compensation Points Distance
P-0-0057 Starting Position
P-0-0058 Table of Correcting Values
P-0-0081 Parallel Output
P-0-0082 Parallel Input
P-0-0095 Position Command Interpolation at MDT Failure
P-0-0097 Absolute Encoder Monitoring Window
P-0-0098 Maximum Model Deviation
P-0-0099 Position Command Value Smoothing Filter Time Constant
P-0-0106 Jerk Limit Value - Bipolar
P-0-0107 Slave Version

Timing Parameters

S-0-0001 Control Unit Cycle Time, (t_{Ncyc})
S-0-0002 SERCOS Cycle Time, (t_{Scyc})
S-0-0003 Minimum AT Transmit Starting Time, (t_{1min})
S-0-0004 Transmit to Receive Transition Time, (t_{ATMT})
S-0-0005 Minimum Feedback Acquisition Time, (t_5)
S-0-0006 AT Transmission Starting Time, (t_1)
S-0-0007 Feedback Acquisition Starting Time, (t_4)
S-0-0008 Command Valid Time, (t_3)
S-0-0088 Receive to Receive Recovery Time, (t_{MTSY})
S-0-0089 MDT Transmit Starting Time, (t_2)
S-0-0090 Command Value Transmit Time, (t_{MTSG})

General Initialization Parameters

S-0-0009 Beginning Address in MDT
S-0-0010 Length of the MDT
S-0-0016 Custom AT Configuration List
S-0-0032 Primary Operation Mode
S-0-0033 Secondary Operation Mode - 1
S-0-0034 Secondary Operation Mode - 2
S-0-0035 Secondary Operation Mode - 3
S-0-0096 Slave Arrangement, (SLKN)
S-0-0127 Communication Phase 3 Transition Check
S-0-0128 Communication Phase 4 Transition Check
S-0-0185 Length of Configurable Data Record of the AT
S-0-0186 Length of Configurable Data Record of the MDT
P-0-0005 Language Selection
P-0-0007 Error Reaction

Interfacing and Diagnostic Parameters

S-0-0011 Class 1 Diagnostics
S-0-0012 Class 2 Diagnostics
S-0-0013 Class 3 Diagnostics
S-0-0014 Interface Status
S-0-0015 Telegram Type Parameter
S-0-0028 MST Error Counter
S-0-0029 MDT Error Counter
S-0-0030 Manufacturer Version
S-0-0095 Diagnostic Message
S-0-0099 Reset Class 1 Diagnostics
S-0-0134 Master Control Word
S-0-0135 Drive Status Word
S-0-0140 Drive Type
S-0-0141 Motor Type
S-0-0142 Application Type
S-0-0143 SERCOS Interface Version
S-0-0182 Manufacturer Class 3 Diagnostics
P-0-0107 Slave Version

Parameter Lists

S-0-0017 ID Number List of All Operation Data
S-0-0021 List of Invalid ID Numbers for Communication Phase 2
S-0-0022 List of Invalid ID Numbers for Communication Phase 3
S-0-0024 Custom MDT Configuration List
S-0-0187 List of Configurable Data of the AT
S-0-0188 List of Configurable Data of the MDT
S-0-0192 List of Backup Operation Data

P-0-0045 IDN List of Control Dependent Application Parameters
P-0-0046 IDN List of Machine Dependent Application Parameters
P-0-0047 IDN List of Drive Parameters
P-0-0048 IDN List of Gain Adjustment Parameters

Control Loop and Application Parameters

S-0-0262 Load Default Gain Parameters - Procedure Command

Velocity Loop Parameters

S-0-0036 Velocity Command Value
S-0-0040 Velocity Feedback Value
S-0-0043 Velocity Polarity Parameter
S-0-0044 Velocity Data Scaling Method
S-0-0045 Linear Velocity Data Scaling Factor
S-0-0046 Linear Velocity Data Scaling Exponent
S-0-0091 Bipolar Velocity Limit Value
S-0-0100 Velocity Loop Proportional Gain
S-0-0101 Velocity Loop Integral Reaction Time
S-0-0108 Feedrate Override
S-0-0113 Maximum Motor Velocity
S-0-0124 Zero Velocity Window
P-0-0004 Smoothing Time Constant

Current / Torque Loop Parameters

S-0-0080 Torque Command Value
S-0-0084 Torque Feedback Value
S-0-0085 Torque Polarity Parameter
S-0-0086 Scaling Options for Torque - Force Data
S-0-0092 Bipolar Torque Limit Value
S-0-0093 Scaling Factor for Torque-Force Data
S-0-0094 Scaling Exponent for Torque-Force Data
S-0-0106 Current Loop Proportional Gain 1
S-0-0109 Motor Peak Current
S-0-0110 Amplifier Peak Current
S-0-0111 Motor Current at Stand Still
S-0-0112 Amplifier Nominal Current
P-0-0006 Overload Factor
P-0-0051 Torque Constant

Acceleration Parameters

S-0-0138 Bipolar Acceleration
S-0-0160 Scaling Options for Acceleration Data
S-0-0161 Scaling Factor for Acceleration Data
S-0-0162 Scaling Exponent for Acceleration Data
P-0-0050 Proportional Gain Acceleration Feed Forward
P-0-0106 Jerk Limit Value - Bipolar

Position Loop Parameters

S-0-0047 Position Command Value
S-0-0049 Positive Position Limit Value
S-0-0050 Negative Position Limit Value
S-0-0051 Position Feedback Value 1, (Motor Encoder)
S-0-0053 Position Feedback Value 2, (External Feedback)
S-0-0055 Position Polarity Parameter
S-0-0057 Position Window
S-0-0076 Scaling Options for Position Data
S-0-0077 Linear Position Data Scaling Factor
S-0-0078 Linear Position Data Scaling Exponent
S-0-0079 Rotational Position Resolution
S-0-0103 Modulo Value
S-0-0104 Position Loop Gain, (KV Factor)
S-0-0115 Position Feedback Type Parameter
S-0-0117 Resolution of Rotational Feedback 2, (External Feedback)
S-0-0118 Resolution of Linear Feedback 2, (External Feedback)
S-0-0165 Distance Coded Scale 1
S-0-0166 Distance Coded Scale 2
S-0-0173 Marker Position A
S-0-0177 Absolute Dimension Offset 1
S-0-0178 Absolute Dimension Offset 2
S-0-0403 Position Feedback Status
S-0-0159 Monitoring Window
S-0-0189 Following Error
P-0-0010 Excessive Position Command Value
P-0-0011 Last Valid Position Command Value
P-0-0012 Set Absolute Measuring Procedure Command
P-0-0014 Determine Marker Position - Procedure Command
P-0-0019 Starting Position Value
P-0-0098 Maximum Model Deviation
P-0-0095 Position Command Interpolation at MDT Failure
P-0-0097 Absolute Encoder Monitoring Window
P-0-0099 Position Command Value Smoothing Filter Time Constant

Single Axis Motion Parameters

S-0-0138 Bipolar Acceleration
P-0-0049 Target Position
S-0-0091 Bipolar Velocity Limit Value
P-0-0106 Jerk Limit Value - Bipolar

Homing Parameters

S-0-0041 Homing Velocity
S-0-0042 Homing Acceleration
S-0-0052 Position Feedback 1 - Reference Distance
S-0-0054 Position Feedback 2 - Reference Distance
S-0-0147 Homing Parameter
S-0-0148 Drive Controlled Homing Procedure Command
S-0-0150 Reference Offset 1
S-0-0151 Reference Offset 2
S-0-0400 Home Switch
P-0-0020 Displacement of the Home Switch

Mechanics

S-0-0121 Input Revolutions of Load Gear
S-0-0122 Output Revolutions of Load Gear
S-0-0123 Feed Constant
S-0-0149 Drive Into Positive Stop Procedure Command
S-0-0155 Friction Torque Compensation

Probing

S-0-0130 Probe 1 - Positive Edge Position Value
S-0-0131 Probe 1 - Negative Edge Position Value
S-0-0132 Probe 2 - Positive Edge Position Value
S-0-0133 Probe 2 - Negative Edge Position Value
S-0-0169 Probe Control Parameter
S-0-0170 Probing Cycle Procedure Command
S-0-0301 Allocation of Real Time Control Bit 1
S-0-0303 Allocation of Real Time Control Bit 2

S-0-0305 Allocation of Real Time Status Bit 1
S-0-0307 Allocation of Real Time Status Bit 2
S-0-0401 Probe 1
S-0-0402 Probe 2
S-0-0405 Probe 1 Enable
S-0-0406 Probe 2 Enable
S-0-0409 Probe 1 Positive Edge Latched
S-0-0410 Probe 1 Negative Edge Latched
S-0-0411 Probe 2 Positive Edge Latched
S-0-0412 Probe 2 Negative Edge Latched

Oscilloscope Function

P-0-0021 Oscilloscope Channel 1 - Acquired Data Samples
P-0-0022 Oscilloscope Channel 2 - Acquired Data Samples
P-0-0023 Oscilloscope Signal Selection - Channel 1
P-0-0024 Oscilloscope Signal Selection - Channel 2
P-0-0025 Trigger Source
P-0-0026 Trigger Signal Selection
P-0-0027 Trigger Threshold for Position Data
P-0-0028 Trigger Threshold for Velocity Data
P-0-0029 Trigger Threshold for Torque Data
P-0-0030 Trigger Mode
P-0-0031 Signal Sample Time (Time Divisions)
P-0-0032 Oscilloscope Signal Memory Allocation
P-0-0033 Number of Samples After the Start of the Recording
P-0-0035 Trigger Offset
P-0-0036 Trigger Control Word
P-0-0037 Trigger Status Word

DDS 2.1 Programmable Analog Outputs

P-0-0038 Signal Selection of the Analog Monitor Output - Channel 1
P-0-0039 Signal Selection for Analog Monitor Output - Channel 2
P-0-0040 Scaling of Velocity Data on the Analog Monitor Output - Chan. 1
P-0-0041 Scaling of Velocity Data on the Analog Monitor Output - Chan. 2
P-0-0042 Scaling of Position Data on the Analog Monitor Output - Chan. 1
P-0-0043 Scaling of Position Data on the Analog Monitor Output - Chan. 2

Axis Error Compensation Function

P-0-0055 Status of Feed Error Compensation
P-0-0056 Compensation Points Distance
P-0-0057 Starting Position
P-0-0058 Table of Correcting Values

DDS 2.1 I/O Parameters

P-0-0081 Parallel Output
P-0-0082 Parallel Input

DDS 2.1 Parameter Log Sheet

S-0-0015	**Telegram Type Parameter**	
S-0-0016	**Custom AT Configuration List**	
S-0-0017	**ID Number List of All Operation Data**	
S-0-0021	**List of Invalid ID Numbers for Communication Phase 2**	
S-0-0022	**List of Invalid ID Numbers for Communication Phase 3**	
S-0-0024	**Custom MDT Configuration List**	
S-0-0032	**Primary Operation Mode**	
S-0-0033	**Secondary Operation Mode - 1**	
S-0-0034	**Secondary Operation Mode - 2**	
S-0-0035	**Secondary Operation Mode - 3**	
S-0-0041	**Homing Velocity**	
S-0-0042	**Homing Acceleration**	

S-0-0043	Velocity Polarity Parameter	
S-0-0044	Velocity Data Scaling Method	
S-0-0045	Linear Velocity Data Scaling Factor	
S-0-0046	Linear Velocity Data Scaling Exponent	
S-0-0049	Positive Position Limit Value	
S-0-0050	Negative Position Limit Value	
S-0-0051	Position Feedback Value 1, (Motor Encoder)	
S-0-0052	Position Feedback 1 - Reference Distance	
S-0-0053	Position Feedback Value 2, (External Feedback)	
S-0-0054	Position Feedback 2 - Reference Distance	
S-0-0055	Position Polarity Parameter	
S-0-0057	In Position Window	
S-0-0076	Scaling Options for Position Data	
S-0-0077	Linear Position Data Scaling Factor	
S-0-0078	Linear Position Data Scaling Exponent	
S-0-0079	Rotational Position Resolution	
S-0-0080	Torque Command Value	
S-0-0084	Torque Feedback Value	
S-0-0085	Torque Polarity Parameter	
S-0-0086	Scaling Options for Torque - Force Data	
S-0-0091	Bipolar Velocity Limit Value	
S-0-0092	Bipolar Torque Limit Value	
S-0-0093	Scaling Factor for Torque-Force Data	
S-0-0094	Scaling Exponent for Torque-Force Data	

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S-0-0100	Velocity Loop Proportional Gain	
S-0-0101	Velocity Loop Integral Reaction Time	
S-0-0103	Modulo Value	
S-0-0104	Position Loop Gain, (KV Factor)	
S-0-0106	Current Loop Proportional Gain 1	
S-0-0108	Feedrate Override	
S-0-0109	Motor Peak Current	
S-0-0110	Amplifier Peak Current	
S-0-0111	Continuous Motor Current	
S-0-0112	Amplifier Continuous Current	
S-0-0113	Maximum Motor Velocity	
S-0-0115	Position Feedback Type Parameter	
S-0-0117	Resolution of Rotational Feedback 2, (External Feedback)	
S-0-0118	Resolution of Linear Feedback 2, (External Feedback)	
S-0-0121	Input Revolutions of Load Gear	
S-0-0122	Output Revolutions of Load Gear	
S-0-0123	Feed Constant	
S-0-0124	Zero Velocity Window	
S-0-0130	Probe 1 - Positive Edge Position Value	
S-0-0131	Probe 1 - Negative Edge Position Value	
S-0-0132	Probe 2 - Positive Edge Position Value	
S-0-0133	Probe 2 - Negative Edge Position Value	
S-0-0138	Bipolar Acceleration	
S-0-0140	Drive Type	

S-0-0141	Motor Type	
S-0-0142	Application Type	
S-0-0143	SERCOS Interface Version	
S-0-0147	Homing Parameter	
S-0-0150	Reference Offset 1	
S-0-0151	Reference Offset 2	
S-0-0155	Friction Torque Compensation	
S-0-0159	Monitoring Window	
S-0-0160	Scaling Options for Acceleration Data	
S-0-0161	Scaling Factor for Acceleration Data	
S-0-0162	Scaling Exponent for Acceleration Data	
S-0-0165	Distance Coded Scale 1	
S-0-0166	Distance Coded Scale 2	
S-0-0169	Probe Control Parameter	
S-0-0173	Marker Position A	
S-0-0177	Absolute Dimension Offset 1	
S-0-0178	Absolute Dimension Offset 2	
S-0-0301	Allocation of Real Time Control Bit 1	
S-0-0303	Allocation of Real Time Control Bit 2	
S-0-0305	Allocation of Real Time Status Bit 1	
S-0-0307	Allocation of Real Time Status Bit 2	
S-0-0405	Probe 1 Enable	
S-0-0406	Probe 2 Enable	
P-0-0004	Smoothing Time Constant	

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P-0-0005	Language Selection	
P-0-0006	Overload Factor	
P-0-0007	Error Reaction	
P-0-0010	Excessive Position Command Value	
P-0-0011	Last Valid Position Command Value	
P-0-0019	Starting Position Value	
P-0-0020	Displacement of the Home Switch	
P-0-0023	Signal Selection - Channel 1	
P-0-0024	Signal Selection - Channel 2	
P-0-0025	Trigger Source	
P-0-0026	Trigger Signal Selection	
P-0-0027	Trigger Threshold for Position Data	
P-0-0028	Trigger Threshold for Velocity Data	
P-0-0029	Trigger Threshold for Torque Data	
P-0-0030	Trigger Mode	
P-0-0031	Time Divisions	
P-0-0032	Memory Allocation	
P-0-0033	Number of Samples After the Start of the Recording	
P-0-0035	Trigger Offset	
P-0-0036	Trigger Control Word	
P-0-0037	Trigger Status Word	
P-0-0038	Signal Selection of the Analog Monitor Output - Channel 1	
P-0-0039	Signal Selection for Analog Monitor Output - Channel 2	
P-0-0040	Scaling of Velocity Data on the Analog Monitor Output - Channel 1	

P-0-0041	Scaling of Velocity Data on the Analog Monitor Output - Channel 2	
P-0-0042	Scaling of Position Data on the Analog Monitor Output - Channel 1	
P-0-0043	Scaling of Position Data on the Analog Monitor Output - Channel 2	
P-0-0049	Target Position	
P-0-0050	Proportional Gain Acceleration Feed Forward	
P-0-0051	Torque Constant	
P-0-0055	Status of Feed Error Compensation	
P-0-0056	Compensation Points Distance	
P-0-0057	Starting Position	
P-0-0058	Table of Correcting Values	
P-0-0081	Parallel Output	
P-0-0082	Parallel Input	
P-0-0097	Absolute Encoder Monitoring Window	
P-0-0098	Maximum Model Deviation	
P-0-0099	Position Command Value Smoothing Filter Time Constant	
P-0-0106	Jerk Limit Value - Bipolar	
P-0-0107	Slave Version	

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APPENDIX G: SOFTWARE RELEASES

DDS 2.1 Software Summary List
(02/18/94)

This list gives a summary of all current software available for the DDS 2.1:

DSM 2.1 Module Software	Version	Official Release Date
SERCOS Software - Standard	S01.09	6/30/93
Analog Command with Incremental Encoder Emulator Output	E01.05	8/3/93
Analog Command with Absolute Encoder Emulator Output	A01.02	8/3/93
Electronic Line Shafting Software (Not yet released, contact Indramat Engineering)	ELS 01.00C	Beta Version
Linear Motor Software (Not yet released, contact Indramat Engineering)	LNS 01.01	In Development

DSS 1.1 SERCOS Card	Version	Official Release Date
Standard Software (Checksum = 4FB6)	DSS-01.01/03	6/26/93

Miscellaneous	Version	Official Release Date
DDS 2.1 Terminal Emulation Software (for PC Computer)	DDS2 PC 01.01	3/3/93

DDS 2.1 Software Release Notes:
S01.08 - 2/15/93

Software Version: S01.08

Drive Configurations to
which software applies : DS01, DS03, DS04 (SERCOS as main interface)

DDS 2.1 hardware index in
which software applies : A03 and higher

Software Module
Identification : DSM 2.1-S11-01.RS

EPROM Identification:	EPROM Type:
INDRAMAT DSM 2.1-S01.08 00L *5D59*	27C256
INDRAMAT DSM 2.1-S01.08 00H *23AE*	27C256
INDRAMAT DSM 2.1-S01.08 01L *3647*	27C512
INDRAMAT DSM 2.1-S01.08 01H *774C*	27C512

DDS 2.1 Software Release Notes
S01.08 - 2/15/93

1. Utilization of the Parallel I/O Card, DEA 4.1:
   - Outputs values in the parameter "Parallel Output", IDN P-0-0081
   - Displays the input status in parameter "Parallel Inputs", IDN P-0-0082.

2. Load Default Gain Values - Procedure Command, IDN S-0-0262
   (load gain parameters out of the feedback).
   The DDS 2.1 downloads the factory set gain parameters for current, velocity and position loops from the motor feedback and activates these values.

3. Updated SERCOS functions in the DDS 2.1 to V 01.02. Therefore, the "SERCOS Interface Version", IDN S-0-0143 has been changed to "V 01.02".

4. Changed the Model Monitoring:
   - Displays the "Maximum Model Deviation" in a new parameter, IDN P-0-0098 in percent. Reference: 100% = 360° on the motor shaft.
   - The "Monitoring Window", IDN S-0-0159, is no longer velocity dependent. Refer to IDN P-0-0098.

Note: When loading parameter files which were saved with the old software version, the "Monitoring Window" parameter, IDN S-0-0159 must be updated. The number of decimal places has been changed in Version S01.08.

5. Number of decimal places for "Linear Encoder Resolution", IDN S-0-0118, has been increased to 5.

Note: When loading parameter files which were saved with the old software version, the "Monitoring Window" parameter, IDN S-0-0118 must be updated. The number of decimal places has been changed in Version S01.08.

6. Expanded the "List of Configurable Data in the AT", IDN S-0-0187 to include:

   S-0-0130 - Probe 1 - Positive Edge Position Value
   S-0-0131 - Probe 1 - Negative Edge Position Value
   S-0-0132 - Probe 2 - Positive Edge Position Value
   S-0-0133 - Probe 2 - Negative Edge Position Value
   P-0-0082 - Parallel Inputs

7. Expanded the "List of Configurable Data in the MDT", IDN S-0-0188 to include:

   P-0-0081 - Parallel Outputs

DDS 2.1 Software Release Notes
S01.08 - 2/15/93

8. Smoothing of the Interpolation Position Command Value through a filter is now possible. This is adjusted via the parameter: "Position Command Smoothing Filter Time Constant", IDN P-0-0099.

9. Adjustment of the NC Cycle Time (= SERCOS Cycle Time) for values other than 2msec is now possible. The following values may be entered: 0.5, 1, 2, ... , 65 msec.

10. The "Position Starting Value", IDN P-0-0019, will force a new position feedback value in Communication Phase 4 when it is enabled in Communication Phase 2.

11. The Modulo Rotational Axis function with load reference using a multiturn absolute encoder is now possible. With this function, it is possible to keep absolute position orientation of a rotational axis without re-homing after power shutdown. Any rational gear ratio is allowed. The axis may also turn continuously in one direction.

DDS 2.1 Software Release
SERCOS Version S01.09
6/30/93

The software version S01.09 will be officially released on 6/30/93 and after this date will be delivered as standard software in all future DDS 2.1 configurations as listed below:

DDS 2.1- xxxx - DS01
DDS 2.1- xxxx - DS03
DDS 2.1- xxxx - DS04
DDS 2.1- xxxx - RS01
DDS 2.1- xxxx - RS03
DDS 2.1- xxxx - RS04

DDS 2.1 Software Release Notes
S01.09 - 6/30/93

Software Version: S01.09

Drive Configurations to
which software applies : DS01, DS03, DS04, RS01, RS03, RS04
(SERCOS as main interface)

DDS 2.1 hardware index in
which software applies : A03 and higher

Software Module
Identification : DSM 2.1-S11-01.RS

EPROM Identification:	**EPROM Type:**
INDRAMAT DSM 2.1-S01.09 00L *3461*	27C256
INDRAMAT DSM 2.1-S01.09 00H *F161*	27C256
INDRAMAT DSM 2.1-S01.09 01L *32C4*	27C512
INDRAMAT DSM 2.1-S01.09 01H *4B58*	27C512

DDS 2.1 Software Release Notes
S01.09 - 6/30/93

1. Support of DDS configurations RS01, RS03 and RS04. Motors with resolver feedbacks must have feedback memory.

2. Axes Error Compensation is implemented.

Parameters:	P-0-0055	Lead Screw Error Compensation Status
	P-0-0056	Sample Period
	P-0-0057	Start Position Table
	P-0-0058	Correction Value Table

For a functional description of the Axes Error Compensation, see application notes.

3. Interpolation of a position command value when a Master Data Telegram is lost. This function is activated with the new parameter IDN P-0-0095, "Position Command Interpolation at the Loss of an MDT", (1 = active).

Note:
Implementing the interpolation results in a delay of the position command value from the control unit cycle. When updating software, all axes which participate in the path interpolation must also be updated to this software revision. When combining S01.09 software with older software, this function must be switched off to avoid path errors.

4. Attributes for ID Number Lists have changed.

5. Monitoring of multi-turn absolute encoders is implemented.
New Parameter:
P-0-0097 Absolute Encoder Monitoring Window
Function: The feedback position is stored when powering down a DDS with a MDD and multiturn encoder. When the system is again powered up, the absolute position given by the encoder is compared with the value which is stored. This occurs during Communication Phase 4 Transition Check. If the deviation between values is larger than the value in the Absolute Encoder Monitoring Window, a Class 1 Diagnostic, (Error 76 - Absolute Encoder Error), occurs. If the distance moved while powered down is greater than the value in the Absolute Encoder Monitoring Window, the error can be reset, otherwise the feedback error remains present.

6. Evaluation of the drives two current values, (Peak - Continuous Current). The actual peak and continuous currents are determined based on the selected overload factor and the peak/continuous current characteristics or the drive/motor combination.

DDS 2.1 Software Release Notes
S01.09 - 6/30/93

7. Remove the monitoring for the compatibility between the telegram type and the operation mode. The error message "217, Telegram Type is Not Supported" should be ignored after switching the telegram type without changing the operation mode.

8. The function which monitors the cyclic feedback signals (sin/cos of the high resolution spur encoder) for signal amplitudes which are too large has been expanded.

9. Monitoring of the feedback signal amplitudes of the non-high resolution spur feedback has been added.

10. Single Axis Mode has been expanded. The modulo position scaling function is now complete.

11. Modulo Position Scaling with an external encoder has been implemented.

12. The addition of the parameter IDN S-0-0103, "Modulo Value", allows the modulo range to be adjusted. Previously, a constant value of 360° was fixed in the drive.

    Warning: ***When using the MT-CNC, a value of 360° must be used.***

13. Parameter IDN S-0-0189, Following Error Distance, has been added in order to display the actual lag error.

14. The behavior of error 30, "Software Overtravel Limit Exceeded, Shutdown", now corresponds to the selected Error Reaction Mode. For error 44, "Overtravel Limit Switch Activated", the drive still performs the best possible deceleration, (switching the velocity command to zero).

15. Homing without an encoder marker pulse, (using a home switch only), is now possible. This is selected in bit 6 of the Homing Parameter, IDN S-0-0147.

16. The Units for IDN S-0-0165 and IDN S-0-0166, "Distance Coded Scale 1 & 2", are changed in the division periods. The division periods now correspond to the grid constants. It is now possible to set parameters for a distance coded rotational encoder.

    Warning: ***If a software update is done, these parameters must be re-programmed.***

17. The parameters IDN P-0-0002, "Velocity Loop Proportional - Derivative Gain" and IDN P-0-0003, "Velocity Loop Derivative - Integral Gain" have been removed.

DDS 2.1 Software Release Notes
S01.09 - 6/30/93

New Parameters:

P-0-0055	Lead Screw Error Compensation Status
P-0-0056	Sample Period
P-0-0057	Start Position Table
P-0-0058	Correction Value Table
P-0-0097	Absolute Encoder Monitoring Window
S-0-0103	Module Value
S-0-0189	Following Error Distance
P-0-0095	Position Command Interpolation at the Loss of an MDT

Removed Parameters:

S-0-0177	Absolute Dimension Offset 1
P-0-0002	Velocity Loop Proportional - Derivative Gain
P-0-0003	Velocity Loop Derivative - Integral Gain

DDS 2.1 Software Release
Analog Version E01.05
7/19/93

The software version E01.05 is officially released and will be delivered as standard software in all future DDS 2.1 configurations as listed below:

DDS 2.1- xxxx - DAxx
DDS 2.1- xxxx - RAxx

DDS 2.1 Software Release Notes: E01.05

Software Version: E01.05

Drive Configurations to which software applies : DDS 2.1- xxxx - DAxx
DDS 2.1- xxxx - RAxx

DDS 2.1 hardware index in which software applies : A03 and higher

Software Module Identification : DSM 2.1-E11-01.RS

EPROM Identification:	EPROM Type:
INDRAMAT DSM 2.1-E01.05 00L *B14D*	27C256
INDRAMAT DSM 2.1-E01.05 00H *C28C*	27C256
INDRAMAT DSM 2.1-E01.05 01L *110C*	27C512
INDRAMAT DSM 2.1-E01.05 01H *F3FB*	27C512

DDS 2.1 Software Release Notes
E01.05 (7/19/93)

General Changes:

1. Only resolver feedbacks with EEPROMs are allowed with DDS 2.1-xxxx-RAxx configurations.

2. The commutation offset was displayed in degrees (elec.). Now the offset is displayed as a unitless number, as it is stored in the feedback EEPROM.

3. Position processing for the Stegmann DSF has been implemented.

4. Position processing for the 6 pole resolver has been implemented.

   [The following feedback devices are now supported on the DDS: Heidenhain DSF, Stegmann DSF, 4 pole resolver (≤ MDD 041) and 6 pole resolver, (≥ MDD 065).]

5. The position output format can now be selected between absolute and modulo format. A requirement is to have a configuration with an absolute encoder emulator (DDS 2.1-xxxx-DA02) and a multiturn encoder. The output format option is assigned in the parameter "Position Output Format" in the Operation Modes / Scaling menu. If modulo position output is selected, then the modulo parameter is displayed in the Incremental Encoder Setup menu. The values for Gear Input Revolutions and Gear Output Revolutions must be entered. These two parameters define the gear ratio. In addition, the counter can be used as an input and for homing position.

   If absolute format was selected, the correct menu for the absolute parameters is shown.

6. The position output format is capable of 2^{12} Increments / Revolution in absolute format and 2^{18} Increments / Modulo Revolution in modulo format.

7. When switching between modulo and absolute formats, the drive must first re-establish its home position before being ready to start.

8. Monitoring of the absolute position has been implemented. This is done by storing the feedback value of the absolute encoder so that when the system is powered down then powered back up, the actual absolute position can be compared with the value that was stored before powering down. If the difference is greater than the value in the Absolute Encoder Monitoring Window, the drive gives an error "76" in the H1 display. This error remains until the S1 reset switch is pressed. The new parameter "Absolute Encoder Monitoring Window" can be found in the Operation Mode / Scaling menu, and this parameter is only displayed if the hardware setup corresponds to the absolute mode, (i.e. multiturn encoder and DAA card are connected). In order to set the Absolute Encoder Monitoring Window, disable the drive with the motor stopped. Input a small value into the monitoring window (e.g. 0.5 revolutions) and make changes correspondingly larger as needed.

9. In the "Parameter Load" menu, the execution of the loading must first be confirmed before proceeding. This problem has been corrected with improved text (i.e. screen instructions).

10. In the "Drive Status" menu, the command value displayed is always the velocity command value. Since this depends on the operation mode selected, it will now display the appropriate command values, (i.e. torque command value for torque loop mode).

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11. The error "91", Configuration Error, now includes the connection between the drive and the feedback. For example, "91" would be displayed if a
DDS 2.1-xxxx-Dxxx were connected to a MDD motor with a resolver feedback.

12. In the future, the parameterization of the feedback, such as the inserting of the commutation offsets, will be implemented by a primary load program. This lays the groundwork for the communications.

13. The parameter "DRP Release Number" has changed. The new name is "Hardware Identification", and the data for this parameter must be taken from the table below:

PC Board	Release Index Number	Hardware Identification
DRP1	/00	0
DRP1	/01	1
DRP1	/02	2
DRP2	/00	2

New Parameters:

P-0-0520	Hardware Identification
P-0-0526	Position Monitoring Window
P-0-0523	Modulo Position Output Active
S-0-0121	Gearing Input Revolutions
S-0-0122	Gearing Output Revolutions
P-0-0524	Modulo Reference Position
P-0-0525	Modulo Counter

General Information for Updating Software

Read all release notes before updating the software in an existing application.

1. Save all parameter sets

Before updating the software in an existing application, it is important to first save the parameters. This is done by going to the "Parameter Save" menu and following the instructions.

2. Exchange the software module

Remove the old software module and replace it with a new module with the updated software.

3. Load the Original Parameter Sets

The parameters which were saved in step 1 above can now be reloaded in the new module by going to the "Parameter Load" menu and following the instructions.

4. Handling of New Parameters

Parameters which are new for the current release must be loaded if they apply to the current application. If a parameter has not been loaded or is considered invalid, its value will be displayed by a sequence of asterisks.

5. Exchanging the EPROMs

If the original DSM module is used and only the EPROM set is exchanged, then perform the following:

Save the parameter sets so that after the EPROM exchange, all parameters can be automatically reloaded.

Remove old EPROMs.

Plug in new EPROMs in the locations specified by the labels. Make sure the orientation of the EPROMs is correct.

Replace the cover of the DSM Module, re-label the module and plug into the drive.

Turn on the drives and upload the saved parameter sets to the drives.

Load the correct values for all new parameters which are to be used.

APPENDIX H: PROGRAMMING LIMITS

CAUTION: *Drawings in this Appendix are included for illustrative purposes only and are subject to change without notice. Check with Indramat to be sure you are working with the latest drawings prior to installing, wiring and powering equipment.*

Application Restrictions of the DDS 2 with S01.09 Software

1. **Modulo Rotational Axes**

The Modulo Range is set through the gear ratio and the modulo value (IDN S-0-0103). The maximum internal range which can be processed is 2048 revolutions of the motor shaft, (i.e., it must be calculated by the following).

$$\frac{\text{Modulo Value in degrees}}{360^\circ} * \frac{\text{Gear Input Revolutions}}{\text{Gear Output Revolutions}} < 2048$$

2. **Absolute Rotational Axes**

The travel range of a rotational axis is a maximum of 2048 motor revolutions in each direction (with the middle point at 0°), (i.e., it must be calculated by the following).

$$0^\circ \pm 360^\circ \times \frac{\text{Gear Output Revolutions}}{\text{Gear Input Revolutions}} \times 2048$$

3. **Linear Axes**

The travel range of a linear axis is a maximum of 2048 motor revolutions in each direction (with the middle point at 0°), (i.e., it must be calculated by the following).

$$0\text{mm} \pm \text{Feed Constant in mm} \times \frac{\text{Gear Output Revolutions}}{\text{Gear Input Revolutions}} \times 2048$$

4. **Homing with a Motor Encoder and Home Switch for Rotational Axes**

The ratio of gear input revolutions to gear output revolutions must be a whole number.

5. **Modulo Rotational Axes with Multi-turn Absolute Encoder**

The ratio of gear input revolutions to gear output revolutions multiplied by 2^{20} must be a whole number.

6. **Parameterization of the Bipolar Velocity Limit Values, (IDN S-0-0091)**

In position loop regulation mode, the received cyclic position command value is monitored. The difference between two consecutive position command values produces a velocity command value. This command value must be smaller than the bipolar velocity limit values. To prevent an internal overflow, the values which are entered for bipolar velocity limit should conform to the following guidelines:

For rotational scaling:

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$$\text{Bipolar Velocity Limit Value} < 20000\ \text{RPM} \times \frac{\text{Gear Output Revolutions}}{\text{Gear Input Revolutions}}$$

For linear scaling:

$$\text{Bipolar Velocity Limit Value} < 20000\ \text{RPM} \times \text{Feed Const.} \times \frac{\text{Gear Output Revolutions}}{\text{Gear Input Revolutions}}$$

7. **Parameterization of Acceleration Values**

The following guidelines must be followed when entering values for Homing Acceleration (IDN S-0-0042) and Bipolar Acceleration Limit Value,
(IDN S-0-0138):

For rotational scaling:

$$\text{Acceleration Value in } {}^{\text{rad}}\!/_{\text{sec}^2} > 1.5 \times \frac{\text{Gear Output Revolutions}}{\text{Gear Input Revolutions}}$$

$$\text{Acceleration Value in } {}^{\text{rad}}\!/_{\text{sec}^2} < 49000 \times \frac{\text{Gear Output Revolutions}}{\text{Gear Input Revolutions}}$$

For linear scaling:

$$\text{Acceleration Value in } {}^{\text{mm}}\!/_{\text{sec}^2} > {}^{1.5}\!/_{6.28} \times \text{Feed Const. in mm} \times \frac{\text{Gear Output Rev.}}{\text{Gear Input Rev.}}$$

$$\text{Acceleration Value in } {}^{\text{mm}}\!/_{\text{sec}^2} < {}^{49000}\!/_{6.28} \times \text{Feed Const. in mm} \times \frac{\text{Gear Output Rev.}}{\text{Gear Input Rev.}}$$

8. **Parameterization of Position Data**

When position data is input, it must be within the travel limits of the drive. Only then will the position data be processed correctly. The travel range of absolute encoders corresponds to points 2 and 3 above. For Modulo Rotational mode, the valid range of values is set by the Modulo Value parameter, IDN S-0-0103.

APPENDIX I: ANALOG INTERFACE - RS 232 NOTES

CAUTION: *Drawings in this Appendix are included for illustrative purposes only and are subject to change without notice. Check with Indramat to be sure you are working with the latest drawings prior to installing, wiring and powering equipment.*

DDS 2.1 RS-232 / Procomm Plus® 2.01 Setup

The following screens show the required settings for communicating to the DDS 2.1 RS-232 port using Procomm Plus, Version 2.01

```
+------------------------------------------------------------------------------+
| PROCOMM PLUS SETUP UTILITY                                 TERMINAL OPTIONS |
|------------------------------------------------------------------------------|
| A- Terminal emulation ........ VT100     K- EGA/VGA true underline ... OFF   |
|                                                                              |
| B- Duplex .................... FULL      L- Terminal width ........... 80    |
|                                                                              |
| C- Soft flow ctrl (XON/XOFF) . OFF       M- ANSI 7 or 8 bit commands . 8 BIT |
|                                                                              |
| D- Hard flow ctrl (RTS/CTS) .. OFF                                           |
|                                                                              |
| E- Line wrap ................. OFF                                           |
|                                                                              |
| F- Screen scroll ............. ON                                            |
|                                                                              |
| G- CR translation ............ CR                                            |
|                                                                              |
| H- BS translation ............ DESTRUCTIVE                                   |
|                                                                              |
| I- Break length (millisecs) .. 0                                             |
|                                                                              |
| J- Enquiry (ENQ) ............. OFF                                           |
|------------------------------------------------------------------------------|
| Alt-Z: Help |     Press the letter of the option to change:       | Esc: Exit |
+------------------------------------------------------------------------------+
```

```
+------------------------------------------------------------------------------+
| PROCOMM PLUS SETUP UTILITY                                  GENERAL OPTIONS |
|------------------------------------------------------------------------------|
| A- Print device ........ PRN               K- Pulldown menu key ... `         |
|                                                                              |
| B- CD high at exit ..... ASK               L- Drop DTR to hangup .. YES       |
|                                                                              |
| C- Enhanced kb speedup . ON                M- File transfer key ... REG       |
|                                                                              |
| D- Remote commands ..... OFF               N- Chat mode ........... BLOCK     |
|                                                                              |
| E- Translation table ... OFF               O- Mouse X sensitivity . 30        |
|                                                                              |
| F- Pause character ..... ~                 P- Mouse Y sensitivity . 28        |
|                                                                              |
| G- Transmit pacing ..... 0   milliseconds  Q- Clipboard separator . 13        |
|                                                                              |
| H- Call logging ........ ON                                                  |
|                                                                              |
| I- Filename lookup ..... ON                                                  |
|                                                                              |
| J- Pulldown menus ...... ON                                                  |
|------------------------------------------------------------------------------|
| Alt-Z: Help |     Press the letter of the option to change:       | Esc: Exit |
+------------------------------------------------------------------------------+
```

® Procomm Plus is a registered trademark of Data Storm Technologies, Inc.

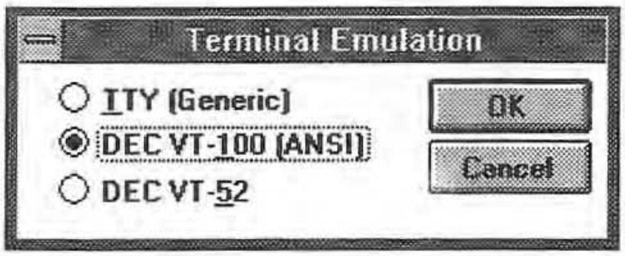
```
+------------------------------------------------------------------------------+
| PROCOMM PLUS SETUP UTILITY                          GENERAL PROTOCOL OPTIONS |
|------------------------------------------------------------------------------|
| A- Protocol timing ............. NORMAL                                      |
|                                                                              |
| B- Aborted downloads ........... KEEP                                        |
|                                                                              |
| C- Abort xfer if CD lost ....... NO                                          |
|                                                                              |
|------------------------------------------------------------------------------|
| Alt-Z: Help |     Press the letter of the option to change:      | Esc: Exit |
+------------------------------------------------------------------------------+
```

```
+------------------------------------------------------------------------------+
| PROCOMM PLUS SETUP UTILITY                            ASCII TRANSFER OPTIONS |
|------------------------------------------------------------------------------|
| A- Echo locally ................ NO    K- CR translation (download).. NONE   |
|                                                                              |
| B- Expand blank lines .......... YES   L- LF translation (download).. NONE   |
|                                                                              |
| C- Expand tabs ................. YES                                         |
|                                                                              |
| D- Character pacing (millisec).. 0                                           |
|                                                                              |
| E- Line pacing (1/10 sec)....... 0                                           |
|                                                                              |
| F- Pace character .............. 0                                           |
|                                                                              |
| G- Strip 8th bit ............... NO                                          |
|                                                                              |
| H- ASCII download timeout ...... 10    seconds                               |
|                                                                              |
| I- CR translation (upload) ..... NONE                                        |
|                                                                              |
| J- LF translation (upload) ..... NONE                                        |
|------------------------------------------------------------------------------|
| Alt-Z: Help |       Press space to toggle, □                                 |
+------------------------------------------------------------------------------+
```

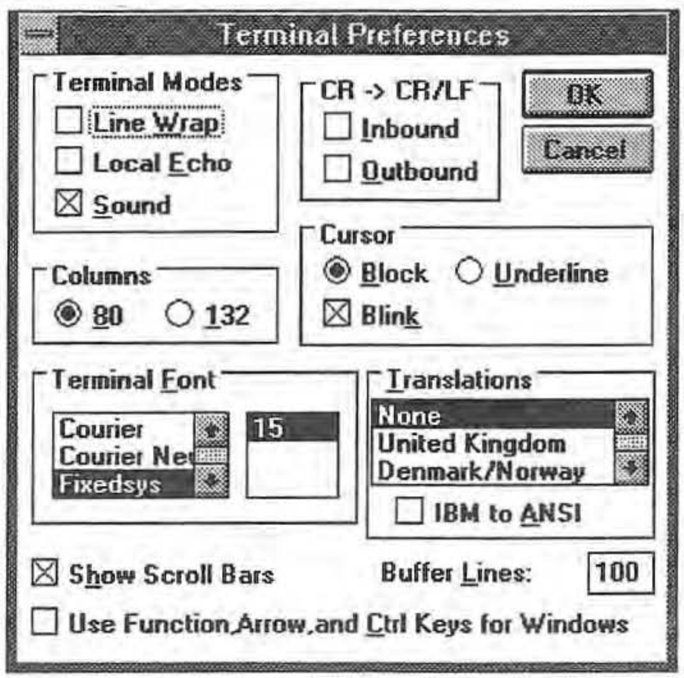
Microsoft Windows® Terminal

The following screens show the setup of this terminal program for use with the DDS 2.1 RS 232 Interface:

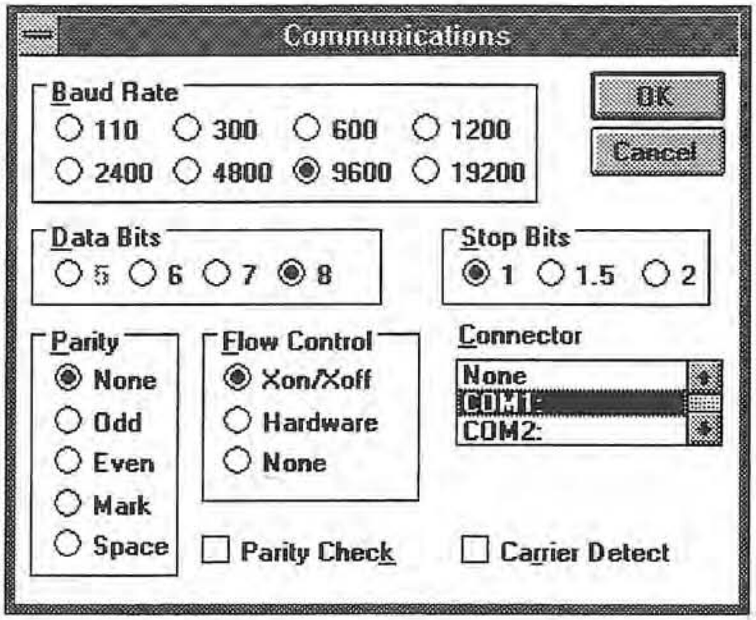
Under the "Settings" menu in the terminal program, Terminal Emulation is shown:



Under the "Settings" menu in the terminal program, Terminal Preferences are shown:



Under the "Settings" menu in the terminal program, Communications are shown:



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