Grip Specifications

- **Manipulator Type**: Hydraulically powered 7-function
- **Construction**: Anodized aluminum & stainless steel
- **Horizontal Reach**: 50.75" (1289 mm)
- **Vertical Reach**: 61.67" (1566 mm)
- **Stowed Height**: 34.54" (877 mm)
- **Maximum Lift Capacity**: 180 lbs (82 kg)
- **Lift Capacity at Full Extension**: 100 lbs (45 kg)
- **Wrist Rotate Torque**: 180 in-lbs (20 Nm)
- **Grip Closure Force (controllable)**: 0-200 lbf (890 N)
- **Degrees Freedom-Of-Motion**: 6 plus gripper
  - **Shoulder Azimuth**: 180 degrees
  - **Shoulder Elevation**: Maximum 120 degrees
  - **Elbow Pivot**: 110 degrees
  - **Wrist Pitch**: 100 degrees
  - **Wrist Yaw**: 105 degrees
  - **Wrist Rotate (slaved mode)**: 340 degrees
  - **Wrist Rotate (continuous)**: 0-40 rpm
- **Jaw Opening (parallel acting)**: 4" (100 mm)
- **Jaw Opening (intermeshing)**: 8.75" (220 mm)
- **Weight**: 130 lbs (59 kg)
- **Weight in Seawater**: 90 lbs (41 kg)
- **Operating Depth, Standard**: 10,000 fsw (3000 msw)
- **Operating Depth, Extended**: 21,000 fsw (6500 msw)

Hydraulic Power Requirements:
- **Operating Pressure**: 1500-3000 psi (104-207 bar)
- **Flow Rate**: 3 gpm (11 lpm)
- **Filtration**: 25 micron absolute
- **Hydraulic Fluid Type**: Shell Tellus® 32 (or equivalent)
  - MIL-H-5606 NATO Code H-515
  - Fire resistant Quaker Quintolubric® 822
- **Mode of Operation**: Position control with force feedback

Operator Control Unit (OCU)
- **Dimensions (LxWxH)**: 15.75"x 8"x3.75" (400x203x95 mm)
- **Weight**: 11.5 lbs (5.2 kg)
- **Power Requirements**: Powered by OCU power chassis
- **Ambient Temperature**: Operating 0°C to +55°C
  - Storage -25°C to +70°C
- **Humidity**: 95%RH max (non condensing)

OCU Power Chassis
- **Dimensions (LxWxH)**: 15.87"x12.25"x5.62" (403x311x143 mm)
- **Weight**: 35 lbs (16 kg)
- **Power Requirements**: Auto select 110/220VAC 50/60Hz
  - 375W max, 180W typical
  - Optional 24VDC 265W max, 130W typical
- **Ambient Temperature**: Operating -20°C to +55°C
  - Storage -40°C to +85°C

KMC 770 Servo Driver Module
- **Dimensions (LxWxH)**: 5"x4.25"x2.46" (127x108x62 mm)
- **Weight**: 1.4 lbs (0.64 kg)
- **Power Requirements**: 6-40VDC 30 Watts
- **Ambient Temperature**: Operating -20°C to +70°C
  - Storage -20°C to +85°C

**Features**
- Rugged field proven design
- Low extended weight
- Base up or base down mounting
- Zero leakage rack & pinion actuators
- Intuitive master/slave control with high fidelity force feedback
- Integral control valves – No separate valve package and hose bundle
Grips is a 7-function, hydraulic manipulator for use on both manned and remotely operated vehicles. Design features which make Grips a good choice for many applications include its box bar linkage design, which allows most of the arm’s weight to be located around its base, and the use of zero leakage rock & pinion actuators which allow Grips to be configured for either base up or base down mounting. Intuitive master/slave control allows even an inexperienced operator to perform work tasks with human like motion and speed. Force feedback dramatically improves operator awareness and allows the operator to perform tasks in unstructured environments. In applications where superb arm dynamics are required, a four bar linkage design, which allows most of the arm’s weight to be located around its base, and the use of zero leakage rock & pinion actuators which allow Grips to be configured for either base up or base down mounting.

Meeting The Challenge

Grips is a mature product with a long history of field service in the most demanding of applications. Since its introduction in 1982, hundreds of Grips manipulator systems have been installed worldwide to complete tasks in deep oceans, and in nuclear, aerospace, electric utility, and military applications. Today Grips operates systems configured in 1970 control system technology. Utilizing or on dry land, when ease of operation, and responsiveness to operator command are important, Grips is the performance leader. Grips can be operated base up, as shown, or mounted in a base down configuration. The highly intuitive nature of the force feedback system greatly reduces the risk of damage to both the work site and the manipulator arm.

A Grips manipulator arm can be configured for ease of maintenance. Optional equipment includes a service tool for easy maintenance. A drip tray for collection of dripping fuel is available. A tooling rack may be added to the base or end effector. A gripper drive may be added to provide grip force feedback. Several tooling packages are available. A power outlet is provided for electric tooling. A central wrench is provided for use with torque wrenches. A hand tool tray is provided for use with hand tools. A central wrench is provided for use with torque wrenches. A hand tool tray is provided for use with hand tools.

Innovation In Control Technology

The KMC 770 advanced operating system offers many standard features which enhance system performance and ease of operation. These features include:

- **One button indexing** - the ability to offset master position relative to the manipulator for operator comfort.
- **Power alignment** - allows the operator to align the master with the manipulator after indexing. This enables the operator to move into alignment with the manipulator with ease.

- **Joint lock** - used to selectively lock one or more axes of the manipulator at that motion at the master has no effect on the locked axis.
- **Joint scaling** - the ability to alter the ratio of master arm movement to manipulator arm movement. Scaling can be established for each joint individually.

Kraft Units - the ability to independently adjust joint limits to prevent arm impact with peripheral equipment.

Proportional control of grip force - greatly enhances manipulator performance and is far superior to on-off control in any position control.

Auto start/stop - allows the operator to automatically start or stop the manipulator using a previously programmed routine.

Remote operation - provides the ability to teach the manipulator a routine or sequence and permanently save it for execution at a later time.

System diagnostics - provides comprehensive tools for evaluating and troubleshooting the system.

**KMC 770 Advanced Operating System**

The KMC 770 control system offers many standard features which enhance system performance and ease of operation. These features include:

- **One button indexing** - the ability to offset master position relative to the manipulator for operator comfort.
- **Power alignment** - allows the operator to align the master with the manipulator after indexing. This enables the operator to move into alignment with the manipulator with ease.

- **Joint lock** - used to selectively lock one or more axes of the manipulator at that motion at the master has no effect on the locked axis.
- **Joint scaling** - the ability to alter the ratio of master arm movement to manipulator arm movement. Scaling can be established for each joint individually.

Joint Units - the ability to independently adjust joint limits to prevent arm impact with peripheral equipment.

Proportional control of grip force - greatly enhances manipulator performance and is far superior to on-off control in any position control.

Auto start/stop - allows the operator to automatically start or stop the manipulator using a previously programmed routine.

Remote operation - provides the ability to teach the manipulator a routine or sequence and permanently save it for execution at a later time.

System diagnostics - provides comprehensive tools for evaluating and troubleshooting the system.
Grips is a mature product with a long history of field service in the most demanding of applications. Since its introduction in 1982, hundreds of Grips manipulator systems have been installed worldwide to complete tasks in deep oceans, and in nuclear, aerospace, electric utility, and military applications. Today Grips systems are configured to fit in almost any control system technology.

In its standard configuration the mini-master® is mounted to a compact, portable, operator-control unit that can be placed or oriented anywhere for convenient operation. A color liquid crystal display allows the operator to view system information and menus. Pushbutton keys surrounding the display allow the operator to select various operating options. Remote pushbutton actions are permanently saved for execution at a later time.

Systems neutral buoyancy technology greatly reduces the risk of damage to the work site and the manipulator arm. A Grip force feedback manipulator arm is used for remote task performance. In its standard configuration the mini-master® is mounted to a compact, portable, operator-control unit that can be placed or oriented anywhere for convenient operation. One button indexing will move into alignment with the manipulator after referencing. When initiated, the master controller automatically stows or deploys the manipulator arm and can also be used to automatically stow or deploy the manipulator arm at the same time. Force feedback makes it possible for two manipulator arms to work simultaneously inside the same work envelope without conflict.

KMC 770 Advanced Operating System
The KMC 770 control system offers many standard features which enhance system performance and ease of operation. The following features include:

• Power alignment – allows the operator to realign the manipulator after executing various commands. The master controller and move into alignment with the manipulator under its own power.

• Joint lock – used to selectively lock one or more axes of the manipulator at that motion at the master has no effect on the locked out.

• Joint scaling – the ability to alter the ratio of master arm movement to manipulator arm movement. Scaling can be established for each individual movement.

Joint limits – the ability for individual joint limits set by the operator to prevent arm impact with peripheral equipment.

Proportional control of grip force – greatly enhances manipulator performance and is superior to conventional rate or position control.

Auto stow/deploy – allows the operator to automatically stow or deploy the manipulator arm from any operational position.

Relieve operation – provides the ability to teach the manipulator a routine or sequence and permanently save it for execution at a later time.

System diagnostics – provides comprehensive tools for troubleshooting the system.
Grips is a 7-function, hydraulic manipulator for use on both manned and remotely operated vehicles. Design features which make Grips a good choice for many applications include an in bar linkage design, which allows most of the arm’s weight to be located around its base, and the use of zero leakage rocker joint actuators which allow Grips to be configured for either base up or base down mounting.

Intuitive master/slave control allows even an inexperienced operator to perform work tasks with human-like motion and speed. Force feedback dramatically improves operator awareness and allows the operator to perform tasks with accuracy and speed. Force feedback greatly reduces the risk of damage to the work environment. In applications where superb arm dynamics and controllability are paramount, Grips delivers. When work tasks can be completed in a timely manner, and with little risk of damage to the work environment, the human-like motion and speed make Grips the obvious choice.

As the vital link between the remote manipulator and the human operator, the KMC 770 control system offers many standard features which enhance system performance and ease of operation. These features include:

- **Auto stow/deploy** – allows the operator to stow or deploy the manipulator arm under its own power.
- **Power alignment** – the ability to adjust the master position relative to the manipulator for operator comfort.
- **Joint lock** – used to selectively lock one or more axes of the manipulator at that position. Forces caused by the master have no effect on the locked axis.
- **Joint scaling** – enables the operator to alter the rate of master arm movement to manipulate arm movement. Scaling can be established for each individual joint.
- **Grip to tool** – enables the individual joint end-effector to perform arm tasks with proportional feedback.
- **Proprietary control of grip force** – greatly enhances manipulator performance and is superior to conventional control systems.
- **Robot operation** – provides the ability to teach the manipulator a routine or sequence and permanently save it for execution at a later time.
- **Teach-to-the-outline** – allows the operator to evaluate assembly and manipulation tasks for the first time, and to teach the manipulator a routine or sequence.
- **Power flow control** – allows the operator to view system information and menus. Pushbutton keys surrounding the display allow the operator to select various peripheral equipment.
- **Remote operation** – provides the ability to control the manipulator from a remote location.
- **System diagnostics** – provides comprehensive data for evaluating and troubleshooting the system.

**Innovation In Control Technology**

The KMC 770 control system offers many standard features which enhance system performance and ease of operation. These features include:

- **One button indexing** – the ability to offset master position relative to the manipulator for operator comfort.
- **Power alignment** – allows the operator to adjust the master relative to the manipulator after energizing. When initiated, the master controller and move into alignment with the manipulator under its own power.
- **Joint lock** – used to selectively lock one or more axes of the manipulator at the master position.
- **Joint scaling** – the ability to alter the rate of master arm movement to manipulate arm movement. Scaling can be established for each individual joint.

**Meeting The Challenge**

Grips is a mature product with a long history of field service in the most demanding of applications. Since its introduction in 1983, hundreds of Grips manipulator systems have been installed worldwide to complete tasks in the deep ocean, and in nuclear, aerospace, electric utility, and military applications. Today, Grips system technology is the performance leader. Hardened in the field, Grips is capable of completing a wide variety of tasks in unstructured environments.

Grips can be operated base up, as shown, or mounted in a base down configuration. The remote manipulator pulls the operator into the center of the workspace as it moves the operator to the position. Force feedback makes it possible for two manipulator arms to work simultaneously in the same workspace, or manipulate a shared object, as if you were handling the object with your own two hands.

**KMC 770 Advanced Operating System**

The KMC 770 control system offers many standard features which enhance system performance and ease of operation. These features include:

- **Auto stow/deploy** – allows the operator to stow or deploy the manipulator arm under its own power.
- **Power alignment** – the ability to adjust the master position relative to the manipulator for operator comfort.
- **Joint lock** – used to selectively lock one or more axes of the manipulator at that position. Forces caused by the master have no effect on the locked axis.
- **Joint scaling** – the ability to alter the rate of master arm movement to manipulate arm movement. Scaling can be established for each individual joint.

**Kraft mini-master®**

The Kraft mini-master® is designed for comfortable left-hand or right-hand operation.

**One button indexing**

One button indexing is the vital link between the remote manipulator and the human operator. The Kraft force feedback mini-master® allows the operator to control complex manipulator motion in a comfortable and intuitive manner. Electric actuators on the individual joints of the master respond to the forces acting upon the manipulator arm, providing force feedback to the operator. Conventional switches on the master provide the operator with direct access to core manipulator functions for faster arm operation. The mini-master® is designed for comfortable left-hand or right-hand operation.

In its standard configuration the mini-master® is mounted to a compact, portable, operator control unit that can be placed near, or next to any operator for system use. A color liquid crystal display allows the operator to view system information and menus. Pushbutton keys surrounding the display allow the operator to select various operating options.
Grip Arm Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manipulator Type</td>
<td>Hydraulically powered 7-function</td>
</tr>
<tr>
<td>Construction</td>
<td>Anodized aluminum &amp; stainless steel</td>
</tr>
<tr>
<td>Horizontal Reach</td>
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<td>Degrees Freedom-Of-Motion</td>
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<tr>
<td>Maximum Shoulder Elevation</td>
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<td>Elbow Pivot Range</td>
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<td>Wrist Pitch Range</td>
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<td>Wrist Rotate (continuous)</td>
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<td>Jaw Opening (parallel acting)</td>
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<td>Weight In Air</td>
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<td>Weight In Seawater</td>
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</tr>
<tr>
<td>Operating Depth, Standard</td>
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</tr>
<tr>
<td>Operating Depth, Extended</td>
<td>21,000 fsw (6500 msw)</td>
</tr>
<tr>
<td>Hydraulic Power Requirements:</td>
<td></td>
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<tr>
<td>Operating Pressure</td>
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</tr>
<tr>
<td>Flow Rate</td>
<td>3 gpm (11 lpm)</td>
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<td>Filtration</td>
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</tr>
<tr>
<td>Hydraulic Fluid Type</td>
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</tr>
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<td>Shell Tellus® 32 (or equivalent)</td>
<td>MIL-H-5606 NATO Code H-515</td>
</tr>
<tr>
<td>Fire resistant</td>
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</tr>
</tbody>
</table>

Operator Control Unit (OCU)

Dimensions (LxWxH) | 15.75"x 8"x3.75" (400x203x95 mm)
Weight | 11.5 lbs (5.2 kg)
Power Requirements
- Powered by OCU power chassis
- Ambient Temperature
  - Operating: 0°C to +55°C
  - Storage: -25°C to +70°C
- Humidity: 95%RH max (non condensing)
- OCU Power Chassis
  - Aluminum enclosure with On/Off switch and LED power indicator
  - Dimensions (LxWxH): 15.87"x12.25"x5.62" (403x311x143 mm)
  - Weight: 35 lbs (16 kg)
  - Power Requirements
    - Auto select: 110/220VAC 50/60Hz
    - 375W max, 180W typical
    - Optional: 24VDC 265W max, 130W typical
    - Ambient Temperature
      - Operating: -20°C to +55°C
      - Storage: -40°C to +85°C
- Humidity: 95%RH max (non condensing)

KMC 770 Servo Driver Module

Dimensions (LxWxH) | 5"x4.25"x2.46" (127x108x62 mm)
Weight | 1.4 lbs (0.64 kg)
Power Requirements
- 6-40VDC 30 Watts
- Ambient Temperature
  - Operating: -20°C to +70°C
  - Storage: -20°C to +85°C
- Humidity: 95%RH max (non condensing)
Telemetry
- Standard: RS-232, RS-422/485, Ethernet
- Optional: Fiber Optic, (single mode / multimode) RF (digital spread spectrum)

Features
- Rugged field proven design
- Low extended weight
- Base up or base down mounting
- Zero leakage rack & pinion actuators
- Intuitive master/slave control with high fidelity force feedback
- Integral control valves – No separate valve package and hose bundle

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Grip Arm Specifications

- **Manipulator Type**: Hydraulically powered 7-function
- **Construction**: Anodized aluminum & stainless steel
- **Horizontal Reach**: 50.75" (1289 mm)
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- **Stowed Height**: 34.54" (877 mm)
- **Maximum Lift Capacity**: 180 lbs (82 kg)
- **Lift Capacity at Full Extension**: 100 lbs (45 kg)
- **Wrist Rotate Torque**: 180 in-lbs (20 Nm)
- **Grip Closure Force (controllable)**: 0-200 lbf (890 N)
- **Degrees Freedom-Of-Motion**: 6 plus gripper
  - **Shoulder Azimuth**: 180 degrees
  - **Maximum Shoulder Elevation**: 120 degrees
  - **Elbow Pivot Range**: 110 degrees
  - **Wrist Pitch**: 100 degrees
  - **Wrist Yaw**: 105 degrees
  - **Wrist Rotate (slaved mode)**: 340 degrees
  - **Wrist Rotate (continuous)**: 0-40 rpm
- **Jaw Opening (parallel acting)**: 4" (100 mm)
- **Jaw Opening (intermeshing)**: 8.75" (220 mm)
- **Weight In Air**: 130 lbs (59 kg)
- **Weight In Seawater**: 90 lbs (41 kg)
- **Operating Depth, Standard**: 10,000 fsw (3000 msw)
- **Operating Depth, Extended**: 21,000 fsw (6500 msw)

Hydraulic Power Requirements:
- **Operating Pressure**: 1500-3000 psi (104-207 bar)
- **Flow Rate**: 3 gpm (11 lpm)
- **Filtration**: 25 micron absolute
- **Hydraulic Fluid Type**: Petroleum / Mineral based oils
  - Shell Tellus® 32 (or equivalent)
  - MIL-H-5606 NATO Code H-515
  - Fire resistant Quaker Quintolubric® 822

Mode of Operation:
- Position control with force feedback

**Footprint**

- **PLAN VIEW**
  - **GRID SCALE**: 1 BLOCK = 4"
  - **ELEVATION**
    - 50.75 [1289mm]
    - 13.90 [353mm]
    - 20.54 [522mm]
    - 5.25 [133mm]
    - 34.54 [877mm]
    - 16.00 [406mm]
    - 16.00 [406mm]
    - 9.00 [229mm]
    - 4.00 [102mm]
    - 5.46 [139mm]
    - 7.00 SQ [178mm]
    - 5.50 SQ [140mm]
    - 17.02 [432mm]
    - 61.67 [1566mm]
    - 50.75 [1289mm]
    - 58.29 [1481mm]
    - 10.28 [261mm]
    - 15.30 [389mm]

- **ELEVATION**
  - **CROSS SECTION**
  - **DRAWING SCALE**: 1 BLOCK = 4"
  - 10.56 [267mm]
  - 11.67 [296mm]
  - 12.50 [318mm]
  - 13.90 [353mm]
  - 20.54 [522mm]
  - 5.25 [133mm]
  - 34.54 [877mm]
  - 16.00 [406mm]
  - 16.00 [406mm]
  - 9.00 [229mm]
  - 4.00 [102mm]
  - 7.00 [178mm]
  - 5.50 [140mm]
  - 17.02 [432mm]
  - 61.67 [1566mm]
  - 50.75 [1289mm]
  - 58.29 [1481mm]

KMC 770 Control System Specifications

- **Module of Operation**: Position controlled with force feedback
- **Power Supply**: 6-40VDC 30 Watts
- **Ambient Temperature**: Operating -20°C to +70°C, Storage -20°C to +85°C
- **Humidity**: 95%RH max (non condensing)
- **Telemetry**: Standard RS-232, RS-422/485, Ethernet
  - Optional Fiber Optic, (single mode / multimode)
  - RF (digital spread spectrum)

Operator Control Unit (OCU)

- **Dimensions (LxWxH)**: 15.75"x 8"x3.75" (400x203x95 mm)
- **Weight**: 11.5 lbs (5.2 kg)
- **Power Requirements**: Powered by OCU power chassis
- **Ambient Temperature**: Operating 0°C to +55°C, Storage -25°C to +70°C
- **Humidity**: 95%RH max (non condensing)
- **OCU Power Chassis**: Aluminum enclosure with On/Off switch and LED power indicator
  - **Dimensions (LxWxH)**: 15.87"x12.25"x5.62" (403x311x143 mm)
  - **Weight**: 35 lbs (16 kg)
  - **Power Requirements**: Auto select 110/220VAC 50/60Hz 375W max, 180W typical
  - Optional 24VDC 265W max, 130W typical
  - **Ambient Temperature**: Operating -20°C to +55°C, Storage -40°C to +85°C
  - **Humidity**: 95%RH max (non condensing)

Features

- Rugged field proven design
- Low extended weight
- Base up or base down mounting
- Zero leakage rack & pinion actuators
- Intuitive master/slave control with high fidelity force feedback
- Integral control valves – No separate valve package and hose bundle