RAPTOR
Force Feedback Manipulator

Features

- Strong – Rugged heavy duty construction
- Powerful – 500 lbs of maximum lift, 200 lbs at full extension
- Compact – Less than 36" x 19" x 8" in stowed configuration
- High Dexterity – 200 degrees of wrist pitch & yaw motion
- Integral control valves – No separate valve package and hose bundle
- Intuitive master/slave control with high fidelity force feedback

Kraft

Kraft TeleRobotics

Performance in Motion™

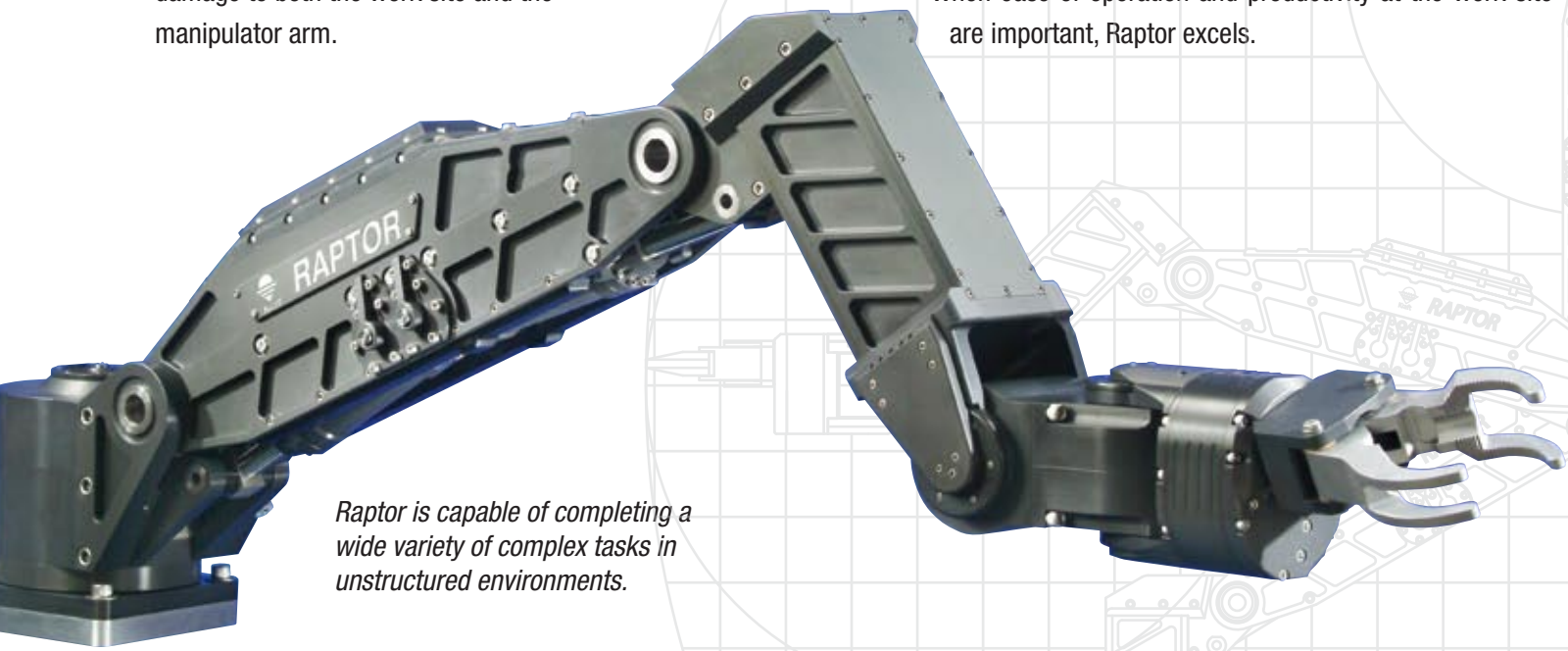
A Tradition of Technological Achievement

Raptor is a 7-function, hydraulically powered manipulator for use in both deep ocean and hazardous inland environments. With 64 inches of reach and a lift capacity of 500 lbs, Raptor delivers powerful manipulator performance in a compact package.

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 more quickly and perform tasks of much greater complexity. In addition to improved telepresence, the compliant nature of a force feedback system greatly reduces the risk of accidental damage to both the work site and the manipulator arm.

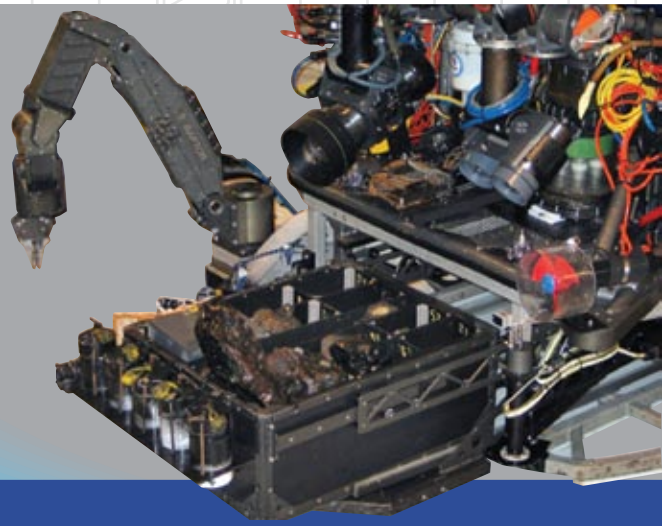
Raptor is the beneficiary of over 25 years of manipulator system development and manufacturing experience. Raptor is a mature product combining field proven technology with simplicity of design. With an emphasis on overall system reliability and field serviceability, the Raptor manipulator arm incorporates fewer components and is less complicated than any other manipulator in its class. By design Kraft manipulator arms minimize overall cost of ownership.

Kraft force feedback manipulator arms have achieved a remarkable track record by demonstrating exceptional performance and reliability in demanding undersea, nuclear, aerospace, electric utility, and military applications worldwide. When ease of operation and productivity at the work site are important, Raptor excels.



Raptor is capable of completing a wide variety of complex tasks in unstructured environments.

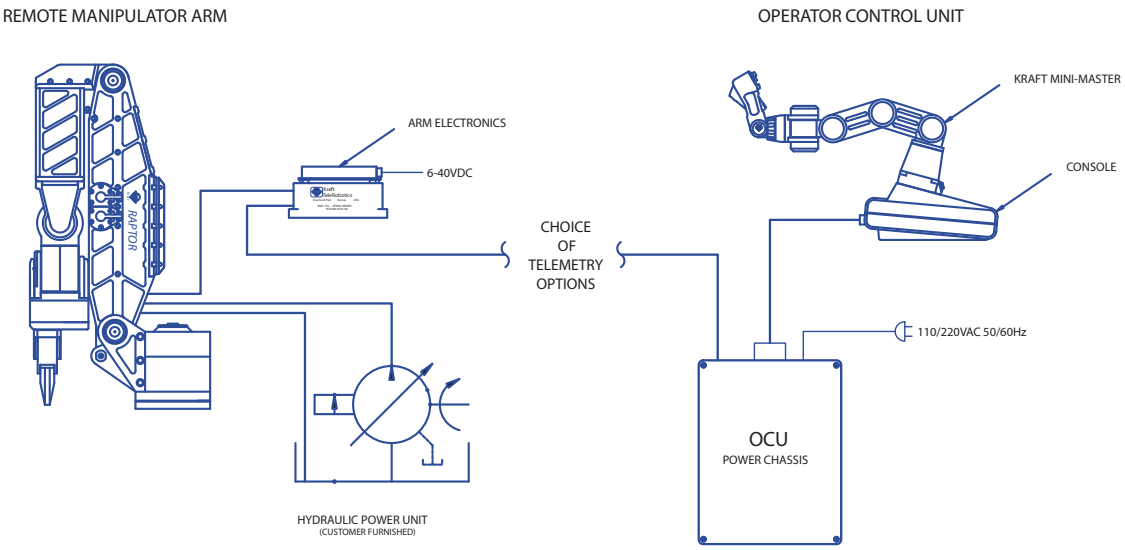
Raptor on the Monterey Bay Aquarium Research Institute (MBARI) deep diving ROV "Tiburon", allows marine scientists to complete a wide variety of tasks in the deep ocean environment.



Raptor's close-coupled wrist with 200 degrees of pitch and yaw motion provides high dexterity where its needed most. A high efficiency piston motor delivers "smooth" wrist roll torque, even at fractional RPM. Kraft's unique method of controlling the gripper allows the operator to proportionally vary the rate of jaw closure, and the amount of grip force.

Raptor is available with either parallel acting, or four fingered intermeshing jaws. Both jaw configurations can grip 3/4" diameter T-handles.

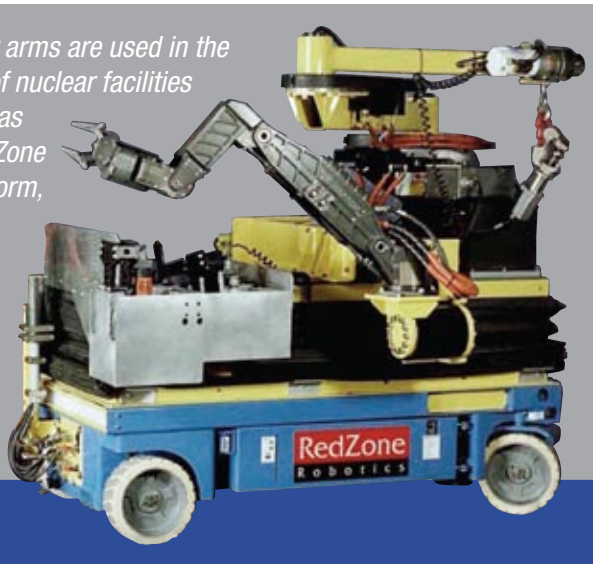
Raptor requires only one electrical connection and a pressure & return hydraulic connection. All valves are packaged as an integral part of the manipulator arm, eliminating the cumbersome hydraulic lines that would be necessary with a remote valve package. A square, four-bolt flange makes mounting the arm simple.



Meeting The Challenge

Raptor force feedback manipulator arms are used to perform a wide variety of tasks in undersea and terrestrial environments. In applications where dexterity and physical strength are important Raptor delivers. When work must be completed in a timely manner, and with little risk of damage to the work site, the advantages provided by a high dexterity force feedback manipulator are significant.

Raptor manipulator arms are used in the decommissioning of nuclear facilities worldwide. Raptor, as shown on the Red Zone "MSRS" work platform, is used in the dismantling of contaminated equipment.



Innovation In Control Technology

As the vital link between the remote manipulator and the human operator, the Kraft force feedback mini-master® allows the operator to control complex manipulator motions 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. Conveniently located switches on the master handgrip 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 on nearly any surface for 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.

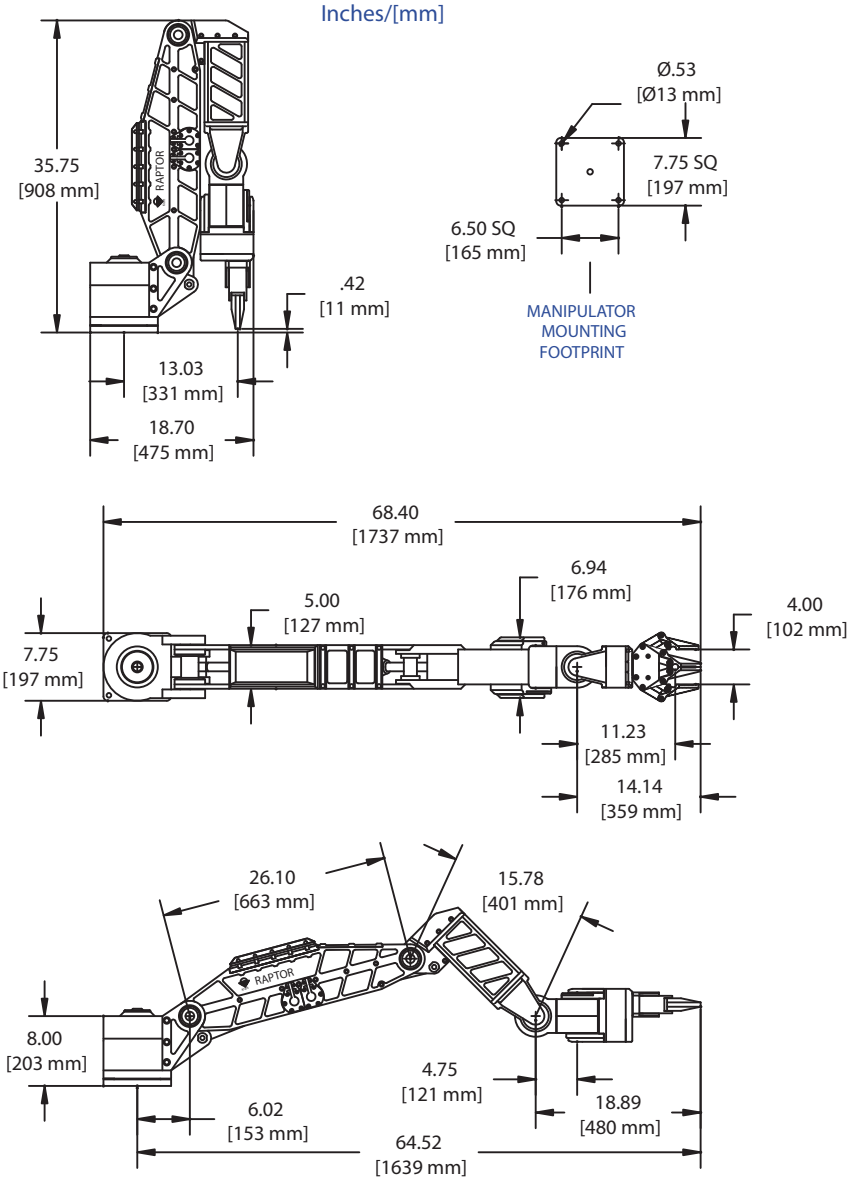
KMC 770 Advanced Operating System

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

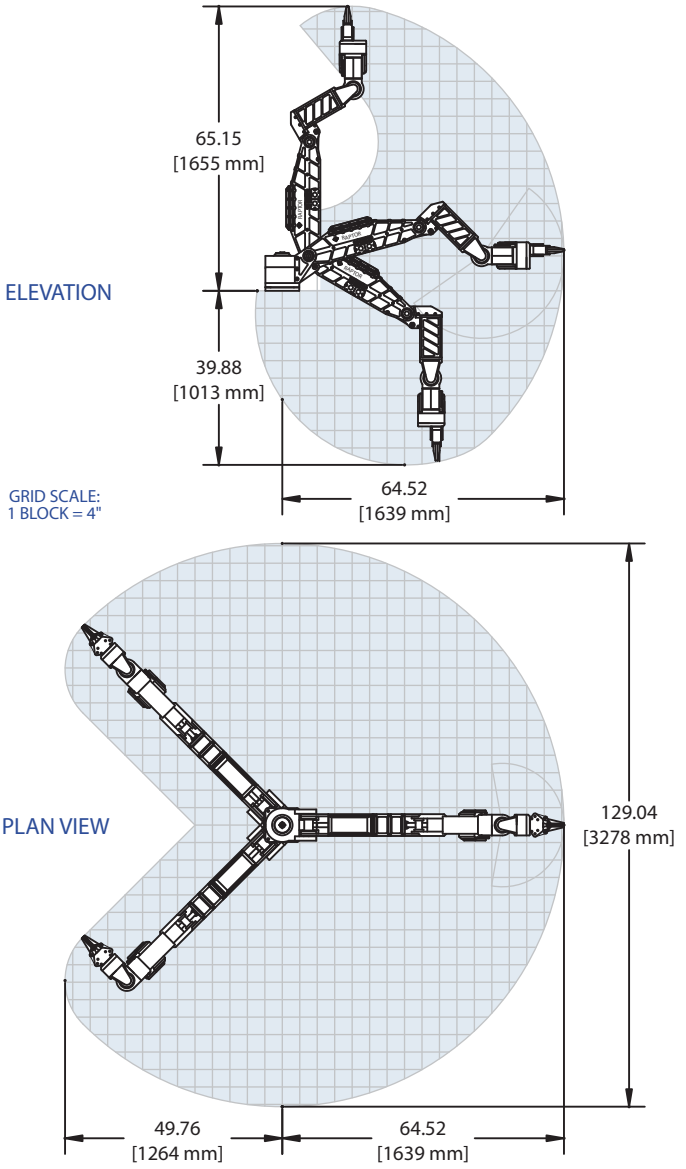
- ***One button indexing*** *– the ability to offset master position relative to the manipulator for operator comfort.*
- ***Power alignment*** *– allows the operator to realign the master with the manipulator after indexing. When initiated, the master controller will move into alignment with the manipulator under its own power.*
- ***Joint lock*** *– used to selectively lock one or more axes of the manipulator so 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 limits*** *– the ability to establish individual joint motion limits to prevent arm impact with peripheral equipment.*
- ***Proportional control of grip force*** *– greatly enhances manipulator performance and is far superior to conventional rate or position control.*
- ***Auto stow/deploy*** *– allows the operator to automatically stow or deploy the manipulator using a previously programmed routine.*
- ***Robotic 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.*

US Air Force "ARTS" vehicle, equipped with dual Raptor force feedback manipulator arms for the remote handling of unexploded ordnance.

OUTLINE DRAWING
Inches/[mm]



PERFORMANCE ENVELOPE



Raptor Arm Specifications

Manipulator Type		Hydraulically powered 7-function
Construction		Anodized aluminum & stainless steel
Horizontal Reach		64.52" (1639 mm)
Vertical Reach		65.15" (1655 mm)
Stowed Height		35.75" (908 mm)
Maximum Lift Capacity		500 lbs (227 kg)
Lift Capacity at Full Extension		200 lbs (91 kg)
Wrist Rotate Torque		1200 in-lbs (135 Nm)
Grip Closure Force (controllable)		0-300 lbf (1334 N)
Degrees Freedom-Of-Motion		6 plus gripper
Maximum Range Of Motion	Shoulder Azimuth	270 degrees
	Shoulder Elevation	120 degrees
	Elbow Pivot	120 degrees
	Wrist Pitch	200 degrees
	Wrist Yaw	200 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		165 lbs (75 kg)
Weight In Seawater		98 lbs (44 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		5 gpm (19 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

KMC 770 Control System Specifications

Mode of Operation	Position control with force feedback
Operator Control Unit (OCU)	Portable console with color display, multi-function keys, and mini-master®
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, provides all necessary power, command and telemetry for the arm
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)

Kraft TeleRobotics INC.

11667 West 90th Street
Overland Park, KS 66214 U.S.A.
Telephone 913-894-9022 • FAX 913-894-1363
Email info@KraftTeleRobotics.com
www.KraftTeleRobotics.com

Publication No. R405-1
Printed in U.S.A.

Performance in Motion™