

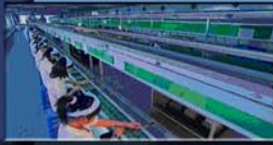


FE Technology Inc.

CUSTOM KEYPADS RUBBER & MEMBRANE

**Complete Die Making
Complete Injection Molding
Metal and Rigid Plastic Backpanels
Complete Graphics Capability
Laser Etched Technology**

*Design Evaluation
Custom Tooling
Graphic Design
Quality Control
Product Testing
JIT Scheduling*





FE Technology Inc.

OEM Manufacturing Specialists

FE Technology is an industry leader in the manufacturing, sales and distribution of custom Rubber and Membrane Keypads. Our organization has over 18 years experience in serving the OEM manufacturers throughout the North American market. We offer the cost advantage of Far East manufacturing backed up with a highly competent local engineering, sales and distribution staff. In addition, our staff in Taiwan and China oversees the manufacturing and quality of your product daily. We are dedicated to establishing a customer/supplier partnership. We will use our resources to find the most economical solution to meet your requirement, offer the highest quality products, and offer the level of service required to fill your specific supplier needs.

PRODUCTS We manufacture custom Keypads to meet our customer's specific requirements. We work with our customers to establish specs that will meet the needs of his application and the environment in which it will be used. Our local engineering and sales staff will work with you every step of the way to achieve the most economical design that will meet the requirements of your specific application. Once the specifications have been established, we will quote the tooling required to manufacture your product and also meet the anticipated production rate. Our factory will build samples from the tooling for your inspection, testing and tooling sample approval. If required, we will work with you to make any tooling modifications required to insure the reliability of your Keypad and meet all functional and environmental requirements for your specific application.

SHIPPING We currently offer two shipping points for JIT delivery -- Ohio and California. We understand the importance of JIT scheduling and we are prepared to work with our customers on specific shipping and warehousing needs, as required. We can also ship direct from our China and Taiwan factories for those customers who require this service.

QUALITY Our factory is ISO certified to ISO 9002. Our factory QA department is highly trained and prepared to offer any QA reports required from IQC through to Final QA. We understand the importance of the high quality required and expected by our customers. We place the highest priority on quality and insuring that you receive a quality product. In addition to our factory QA testing and procedures, we also do QA at our USA warehouse to doubly insure that nothing has been missed at the factory or insure that product has not been damaged while in transit from the Far East.

SERVICE In today's market, service distinguishes the supplier who is truly an extension of your Engineering, Purchasing and Production departments. We recognize the necessity for service and are available to provide this vital link. Our goal is to be an integral part of your organization and be considered an "external, but connected, function" of your company.

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CUSTOM KEYPADS

Membrane Style

Membrane Switch Design Information

Membrane Keypads are custom designed by FET to meet each customer's unique requirements. Our goal is to incorporate our customers' special needs in a cost effective manner that will meet or exceed the design operating criteria. The information presented in these pages is for consideration in your design to help achieve the optimum design for your application.

Precision Manufacturing For Maximum Reliability

FE Technology provides precision manufacturing, which provides our customers with millions of operational cycles, even under the most extreme operating conditions. Circuit traces and contact pads are silk-screened to the highest standards. Work is performed in a positive-pressure clean room environment using materials of the highest quality. Conductive inks contain a silver base only; no fillers or additives are used.

Complete Integrated Membrane Switch Solutions

FE Technology prides itself on the the highest quality in the design and manufacturing of silkscreen printed products and high quality membrane switches, sub-panels and overlays. We provide comprehensive design and manufacturing services for metal and poly-dome membrane switch panels. We excel in membrane keypad solutions, from subassemblies to complex integrated switch panels that include graphic overlays, shielding and backplanes.

Quality and Reliability For Critical Applications

FE Technology offers unsurpassed quality in membrane switch solutions for both standard and custom applications. A broad range of features and options are available to meet your needs for high reliability, EMI/RFI/ESD protection, protection from harsh environments, and easy-to-read high definition graphics

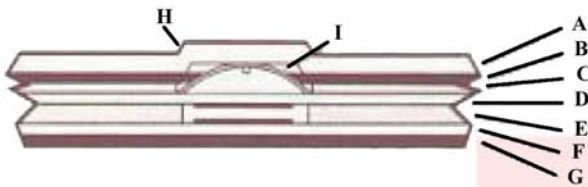




CUSTOM KEYPADS

Membrane Style - Metal Dome

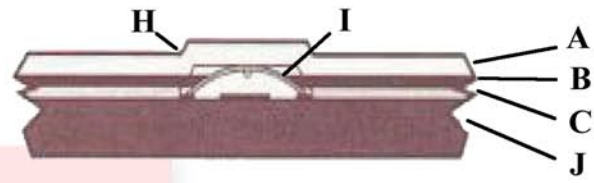
Tactile dome only (Type MDT)



Features:

- Crisp “snap” when key is activated
- Nominal actuation force: 10-24 ounces
- Actuation force tolerance: +/- 3 ounces
- Travel: 0.15” to 0.25” (low travel)

Dome as circuit element (Type MDC)



Features:

- Same features as Type MDT, but also has a printed circuit board which could carry a display or other electronics.
- Can also be used with a polyester lower circuit (with printed silver) to provide a lower cost version of the MDT

Cross Section Key for Type MDC or MDT

- A: Overlay (polyester recommended)
- B: Dome retainer (acrylic adhesive and polyester)
- C: Dome spacer (acrylic adhesive and polyester)
- D: Upper circuit (polyester with printed silver)
- E: Circuit spacer (acrylic adhesive and polyester)
- F: Lower circuit (polyester with printed silver)
- G: Mounting adhesive (acrylic)
- H: Full key embossing (recommended with metal domes)
- I: Metal Dome
- J: Printed Circuit Board (with switch contacts)





CUSTOM KEYPADS

Membrane Style - Metal Dome

Cross Section Key for Types FMK, PMK, and TGK

- A: Overlay (polyester recommended)
- B: Upper circuit (polyester with printed silver)
- C: Circuit spacer (acrylic adhesive and polyester)
- D: Lower circuit (polyester with printed silver)
- E: Mounting adhesive (acrylic)
- F: Tactile spacer (acrylic adhesive and polyester)
- G: Full key emboss (recommended with tactile)
- H: Formed dome on upper circuit
- I: Formed dome on graphic

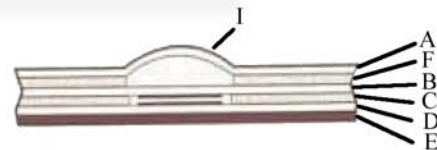
Flat Membrane (Type FMK)



Features:

- Lowest cost
- Normal actuation force: 4-12 ounces
- Actuation force tolerance: +/- 3 ounces
- Minimal tooling costs
- Up to 10 million actuations
- Can be embossed
- Travel: 0.006" to 0.012" (micro-travel)

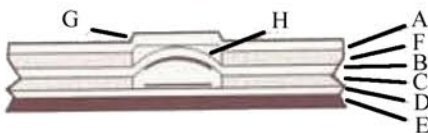
Tactile graphic (Type TGK)



Features:

- Definite "snap" when key is activated
- Normal actuation force: 8-20 ounces
- Actuation force tolerance: +/- 4 ounces
- Tooling and unit price less than PMK while still providing tactile feedback
- Up to 1 million actuations
- Travel: 0.02" to 0.03" (low travel)

Polydome membrane (Type PMK)



Features:

- Definite "snap" when key is activated
- Normal actuation force: 8-24 ounces
- Actuation force tolerance: +/- 4 ounces
- Up to 1 million actuations
- Full key emboss is recommended
- Travel: 0.02" to 0.03" (low travel)



CUSTOM KEYPADS

Membrane Style - Overlay

Artwork

- FET accepts all forms of artwork but prefers the following formats:
Adobe Photoshop Adobe Illustrator-AI or EPS
Adobe InDesign Quark Express
Autocad-DWG or DXF ProE

Material

- Polyester .005 to .010 Gloss or Matte
- Polycarbonate .005 to .020 Gloss or Matte

Color Matching

- Pantone Matching System (PMS####)
- The Munsell Color System
- Color Samples-Preferred samples are 3" x 3" on printed Polyester or Poly carbonate

Textured Background

- Pre-Textured Material or Printed Texture

Window Finishes

- Fine Textures, Velvet Textures, Satins, Glosses, or Special
- Custom Designed Patterns

Embossing

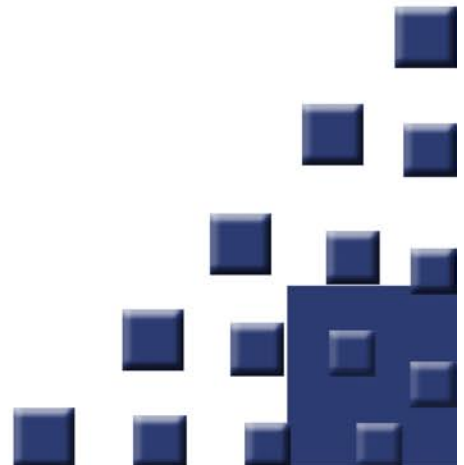
- Pillow, Perimeter, Dome, Braille or Multiple Embossing within a keypad.
- Perimeter Embossing requires a minimum thickness of .030".
- Key-to-Key distances should be a minimum of .050".
- Embossing Draft Angles are a minimum of 3 degrees.

Die Cutting Tolerances

- Typical tolerances are +/- .010"

Overlay Adhesive

- Acrylic adhesive is recommended for Polycarbonate or Polyesters.
- Silicone rubber adhesive is recommended for Silicone Overlays.





CUSTOM KEYPADS

Membrane Style - Switch

Material

- Polyester is the most commonly used switch material.
- Thickness-.003 to .010

Conductive Traces

- Conductive Traces are generally Printed Silver or Etched, Plated Copper
- Traces usually have a Minimum Line Thickness of .016"
- Standard Line Thickness .025"

Tactile Feel

- There are two types of domes: Stainless Steel and Mylar .

Insulator

- Insulators vary in thickness from .002" to .010" and are generally polyester with double-sided acrylic adhesive.

Sub-Panel

- Aluminum - Anodized, sealed, unsealed, dyed or undyed, or iridited
- Cold Roll Steel - Plated with, Chrome, Zinc, or other plating
- Stainless Steel - Brushed, Sanded, other finishes.
- Plastic Panel
- Printed Circuit Board - Single or Multi-Layer

Connectors

- .100" pitch Male, Female, and Solder Tab
- Plating Tin or Gold
- ZIF Zero Insertion Force Connector

PCB

- The PCB can act as the lower switch layer.
- All other layers can be assembled above the PCB.
- Studs or standoff can be integrated into the PCB with the PCB acting as a supporting panel.



CUSTOM KEYPADS

Membrane Style - Switch Electrical and Mechanical

Electrical

- Configuration momentary SPST normally open
- Current Rating 30V/100ma to 120V/10ma maximum
- Breakdown 220 V RMS
 - Closed 100 OHMS typical contact resistance
 - Open 10 MEG OHMS contact resistance minimum
- Capacitance 30 Picofarad
- Life
 - Flat Switch 5 million cycles
 - Domed (embossed) layer 5 million cycles
 - Domed circuit 1 million cycles
 - Metal Dome 5 million cycles
- Contacts Silver to Silver. (Other contacts available)

Mechanical

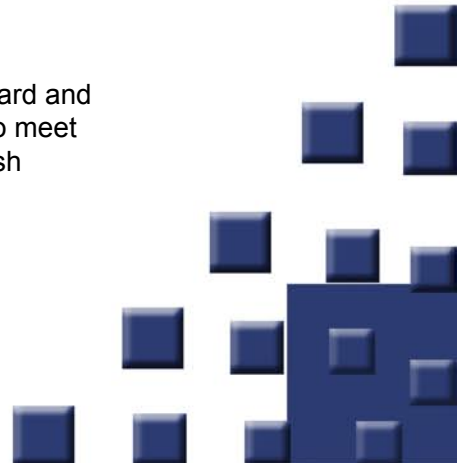
- | | <u>Flat Touch</u> | <u>Tactile</u> |
|-------------|-----------------------------|-----------------------------------|
| • Travel | 0.005" to .012" | 0.015" to .030" |
| • Contact | 5 to 10 milliseconds bounce | 0 to 30 milliseconds bounce |
| • Actuation | 4 to 24 ounces force | 6 to 32 ounces force |
| • Life | 5 million cycles | 5 million cycles (Domed) |
| • Assembly | 0.040" typical thickness | 0.030" to .048" typical thickness |

Environmental

- Operating Temperature 0° C to 85° C
 - 70° C for Standard Dome
 - 85° C for High Temp Dome
- Storage Temperature 40° C to 85° C
- Thermal cycling 0° C to 85° C – 1000 cycles
- Mechanical shock No Closure @ 25 g's

Quality and Reliability For Critical Applications

FE offers unsurpassed quality in membrane switch solutions for both standard and custom applications. A broad range of features and options are available to meet your needs for high reliability, EMI/RFI/ESD protection, protection from harsh environments, and easy-to-read, high-impact graphics.





CUSTOM KEYPADS

Membrane Design Styles

FE Technology is available to work with the customer to assist in the design of a custom membrane keypad to meet the design and application goals of the program. We can provide custom shapes, custom graphics, various switch types and the interconnect required for the customer's application. The examples below are typical customer applications:



Embossed key frame with or without tactile feedback



Raised key with Metal dome, tactile feedback and connector termination



Flat keypad without tactile feedback



Raised key with Mylar or Metal Domes and tactile feedback



CUSTOM KEYPADS

Rubber Style

FE Technology has many years of experience in designing, manufacturing, and supplying our USA customers with the highest quality Rubber Keypads. We manufacture to meet our customer's specific needs and design goals. We will work with you from design concept to finished product. We recognize the wide variety of design features required by each of our customers, and provide whatever assistance is required and make recommendations where we see upside benefits for our customer. We are your full service, fully qualified manufacturer for your Custom Rubber Keypad requirements.

Support Services

- Engineering and Design Assistance, with Our Experienced Staff
- Complete Art, Engineering and Manufacturing Facilities
- Quality Assurance

Capabilities/Processes

- Auto Cad and Pro/E
- Complete Die Making
- Complete Injection Molding Facilities
- Metal and Rigid Plastic Backpanels with Studs and Standoffs
- Full and Selective Key Coatings - Silicone, Silicon, Duracoat, Epoxy
- Laser Etched Technology
- Complete Turnkey Assemblies

Design Features

- Wide array of design possibilities for momentary switch configuration
- Keytops can be multicolored keys with printed legends and coatings
- Choice of tactile feel
- Translucent or phosphorescent materials are available for applications requiring lighted keypads
- Available with epoxy capping, various coatings and laser etched technology



CUSTOM KEYPADS

Rubber Style - Properties

Physical Properties

- Specific Gravity at 25° C: 1.10 to 1.20
- Material Hardness: 50 to 90 ± 5 Shore A
- Tensile Strength: 60 to 90 Kg/cm
- Elongation: 200 to 500%
- Tear Strength: 15 to 20 Kg/cm
- Compression Set: 50 to 60%

Mechanical Tolerances

- Less Than 0.400 : +/- 0.004/in
- 0.400 to 0.790 : +/- 0.006
- 0.791 to 1.148 : +/- 0.008
- 1.185 to 1.574 : +/- 0.010
- 1.575 to 1.920 : +/- 0.012
- Over 1.920 : +/- 0.7

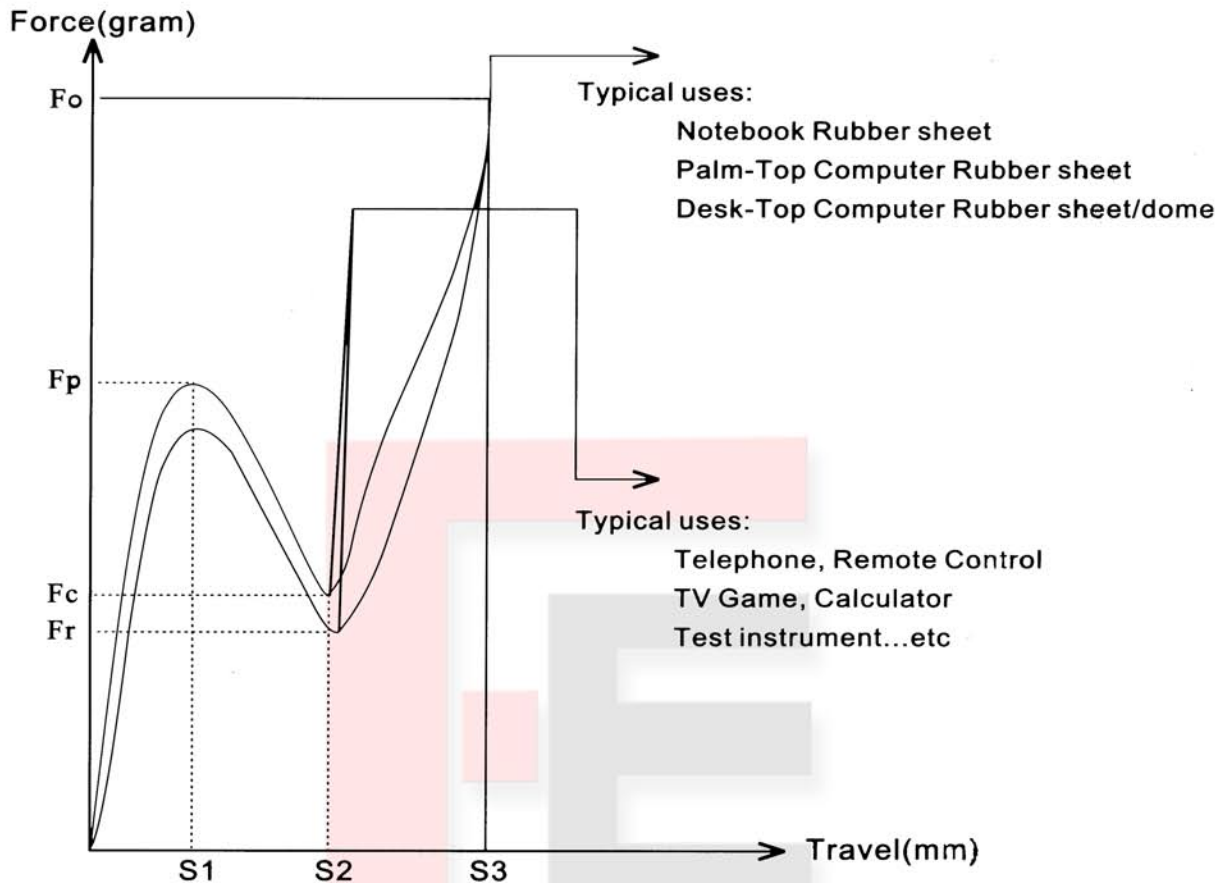
Electrical Specifications

- Contact Resistance <200 Ohms at 120VDC, 300 ma
- Actuation Force 80 to 150 grams ± 25 grams
- Operation Life >1 x 10⁶ cycles
- Contact Bounce 15 ms typical
- Contact Loading 12V DC/10mA max
- Travel 0.8 to 1.0 mm typical
- Operating Temperature -40 to 250° C
- Storage Temperature -50 to 250° C
- Dielectric Strength 24kV/mm of thickness
- Dielectric Constant 2 to 3 MHz
- Insulation Resistance 100 Megohms @ 250VDC
- Insulation Breakdown 26K/mm



CUSTOM KEYPADS

Reference for rubber key design



Force / Travel Diagram of rubber key

F_p = Peak Force

F_c = Contact Force

F_r = Return Force

F_o = Overtravel, Post Travel Force

S1 = Peak Travel

S2 = Contact Travel

S3 = Total Travel

F_d = Drop Force = Click = $F_p - F_c$

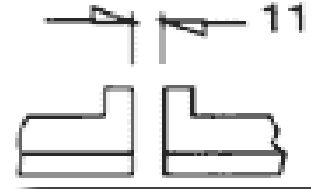
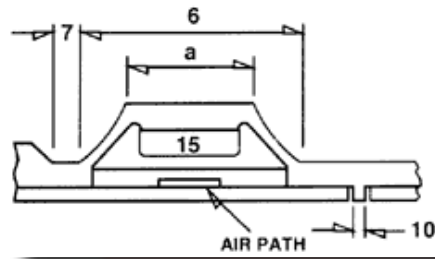
Click Ratio = F_d/F_p = Tactile Feeling



CUSTOM KEYPADS

Rubber Style - Properties

Mechanical Design for Keypad Web



Notes:

- Minimum curvature 1.0 mm Ø
- 1.5 mm
- See 1 and 2
- 1.5 mm
- 0.2 mm minimum
- 1.5 mm
- $\geq 1/2 h$
- Symmetrically placed no farther than 5 mm apart
- Conductive Pill - 2.0 to 8.0 mm Ø x 0.60 mm thick
- Stabilizing posts provided to minimize wobble
- Minimum curvature 0.5 mm Ø
- 1.5 mm
- $a + 2.5$ mm
- $H < 7$ mm, $R = 0.4$; $7 < H < 10$ mm, $R = 0.9$
- 1.5 mm
- 0.3 mm

Silicone Rubber Keypad Contacts

Contact Pills -- Standard Sizes (all dimensions are in mm)






Silver	White/Carbon	Stainless Steel	Gold
Round	Round	Round	Round
1.5	2.0	3.0	3.0
2.0	2.5	3.5	4.0
2.5	3.0	4.0	5.0
3.0	3.5	5.0	
3.5	4.0	7.0	
4.0	4.5		
4.5	5.0		
5.0	6.0		
6.0			
Custom Size Contact Pills Available			



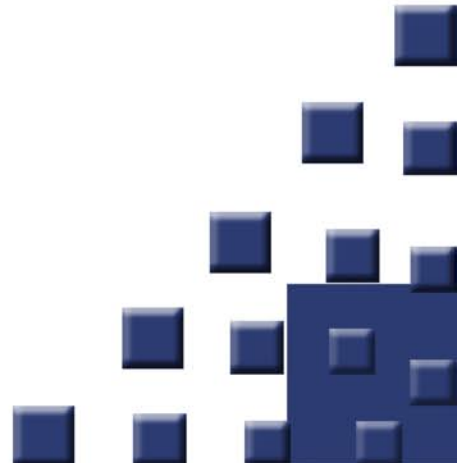
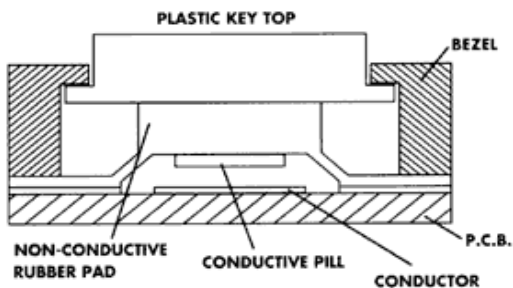
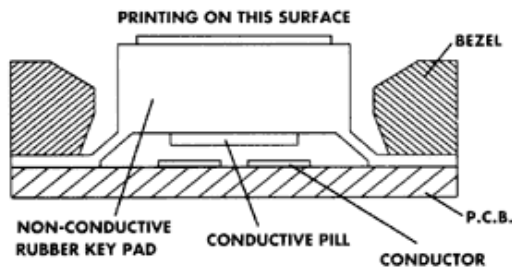
CUSTOM KEYPADS

Rubber Style - Properties

Tactile Characteristics of rubber keypad design

<u>Item</u>	<u>Cone</u>	<u>Double Cone</u>	<u>Bell</u>	<u>Double Bell</u>	<u>Flat</u>
					
Range of Pressure (grams)	30-250	50-250	80-200 10-200 (non click)	30-200	----

Typical Design and Construction





CUSTOM KEYPADS

Rubber Design Styles

FE Technology can design a custom keypad for every requirement. We produce quality silicone rubber keypads to keep your products looking sharp in the market place.

From backlighting and OP2 spray coating to epoxy coatings and plastic protective key caps. We can meet your every design requirement.

These are only a few examples of our capabilities. We look for the opportunity to review your design and work with you to meet your design requirements and objectives.



Silicone keypad



Color key top with print



Key top with clear epoxy protective coating



Keypad with translucent numbers, text and graphics



FE Technology Inc.

Ready to serve OEM Customers throughout the USA. We are the choice of many large and small OEM factories.

EXPERIENCE: 20 years serving the USA market

RESPONSIVE: We can review and respond to your specs, sometimes overnight. We can expedite manufacturing and shipment of your products.

QUALITY: With our highly trained factory staff and local QC and QA, we doubly insure the quality of the product you receive.

SERVICE: In today's market, service distinguishes the supplier who is truly an extension of your Engineering, Purchasing and Production departments. Our goal is to be an integral part of your organization and be considered an "external, but connected, function" of your company.

OTHER PRODUCTS FROM FE TECHNOLOGY

- POWER ADAPTERS** AC/DC AC/AC Switching
- POWER SUPPLIES** Desk Top Wall Mount Open Frame
- BATTERY CHARGERS** Non Regulated Smart Chargers
- DC/DC POWER** Cigarette Lighter Style Desk Toy Style
- TRANSFORMERS** Lam & Ferrite Power Coils Chokes Inductors
- CUSTOM OEM CABLES** Molded Assembled OBD USB 1394
- CUSTOM HARNESSSES** Built to customer specifications
- ANTENNAS** Molded Rubber Steel Protatable
- TELCO PRODUCTS** Jacks Cords CAT5 CAT6
- POWER CORDS** SPT SJT SVT
- TURNKEY PRODUCTION & PCB ASSEMBLY**

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