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Modular Target Cables for Motorola MCU Development Systems

By Steven McAslan and Gordon Price
Motorola, Ltd.
East Kilbride, Scotland

Introduction

Target cables connect the emulation equipment (for example, EVS, MMEVS, or MMDS) to the user's target system or product by providing an interface from the emulator to the MCU socket in the user's system. The target cables are modular and allow for a large range of different target packages. This bulletin describes the target cable strategy that supports the Motorola M68HC05, M68HC08, and M68HC11 MCU Families.

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Modular Target Cable Concept

Traditionally, each MCU package style requires the use of a unique cable. The provision of a new cable design for each new MCU option becomes both a major task and a major expense. However, a modular approach allows reuse of common parts of target cables, allowing more rapid cable development and reduction of costs.

The modular cable strategy uses a small set of common cables with exchangeable target package adapter boards (target heads) to support many different MCU/package combinations. Each cable supports different packages simply by changing target heads. Since target package sizes vary considerably, it is appropriate that the cables take this into account. It is, therefore, possible to provide cables with very small target heads using small packages such as SOIC and DIP.

Motorola offers five cables to provide a broad range of support ranging from the smallest package types to some of the largest. Each target cable has a predefined pin configuration, including default ground placements. The number of signals carried by each cable defines the maximum pin count of the package. However, within this limit, a target head for any package type may be used. **Figure 1** and **Figure 2** illustrate the structure and use respectively.

Since the position of the power and ground pins on each MCU package type has many different possibilities, customizing each target head for a particular MCU/package combination is usually necessary. This in turn allows the target head to reflect particular needs of the MCU, for example concerning analog or high-frequency inputs.

Different target package types require unique approaches for target head connection since different mounting techniques exist for each package type. For example, surface mount technology uses a different mounting approach from through-hole technology.

This bulletin explains each approach with comments about advantages, disadvantages, and limitations.

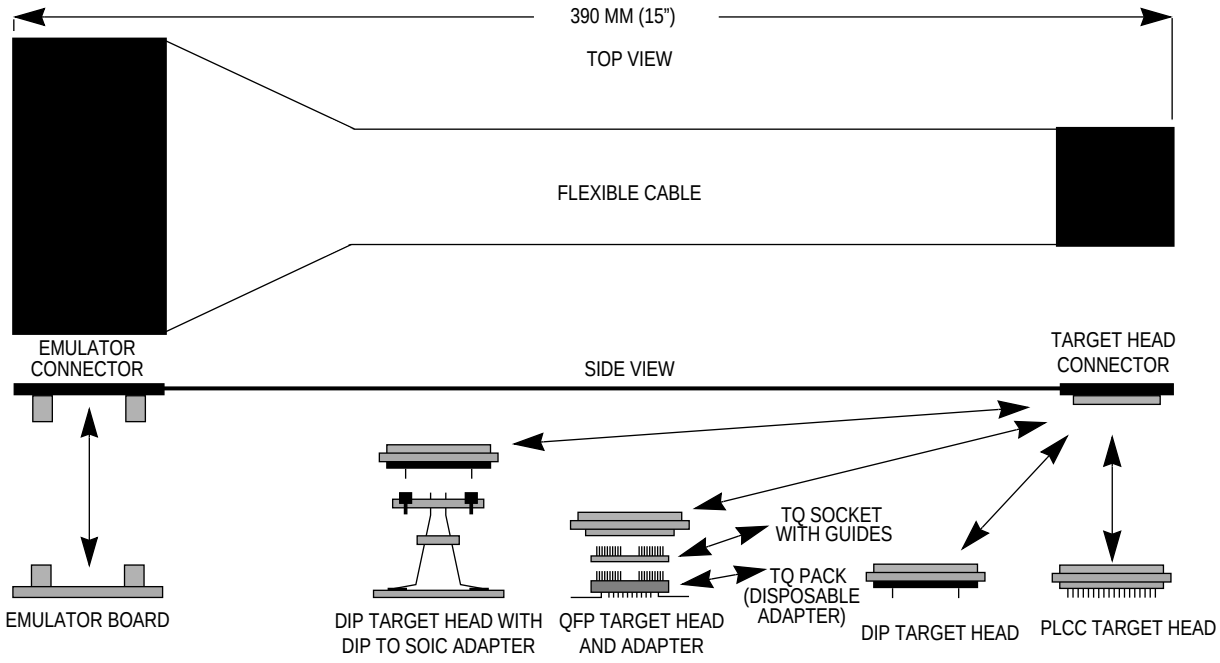


Figure 1. Structure of the Modular Target Cable with Various Target Heads

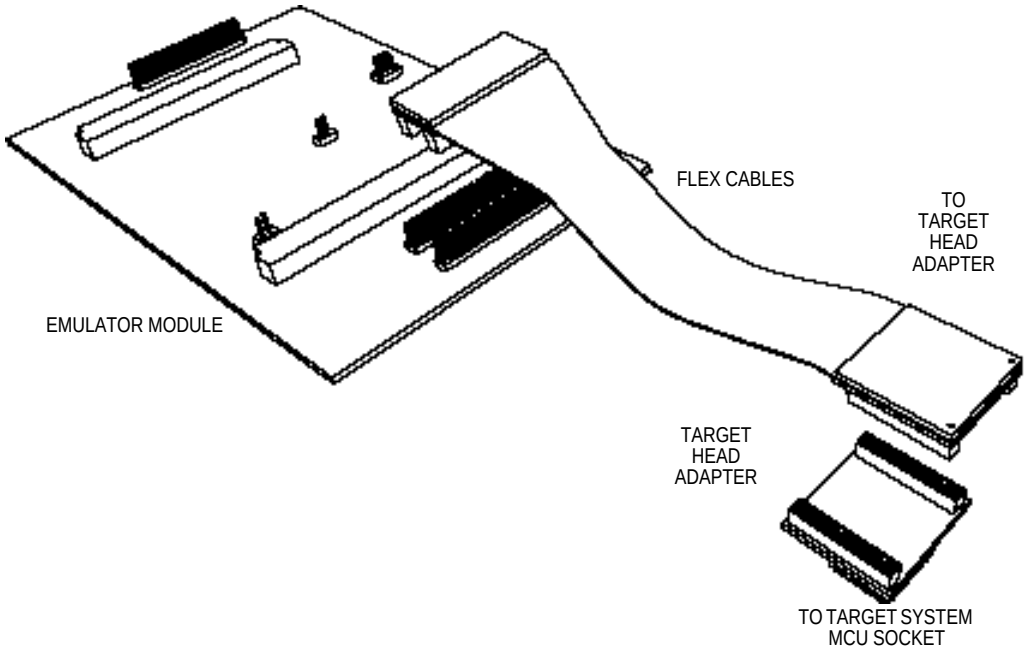


Figure 2. Modular Target Cable Use

NOTE: *On occasion it could be necessary to connect an MCU to the target system instead of to the emulation system. A typical example is when the user has programmable devices available and wants to perform a final system evaluation with the MCU installed in the system. The following paragraphs and diagrams also illustrate these options.*

Each QFP target head adapter includes one xxx pin TQSOCKET with guides (M68TQSxxxSyG1) and one TQPACK disposable adapter (M68TQPxxxSy1, 1.2 mm-lead length, or M68TQPxxxSyMO1, 1.6-mm-lead length). One additional TQPACK must be purchased for each additional target system. The TQSOCKET is reusable, but can also be purchased separately. Refer to the surface mount adapter column in the configuration and order information table for Motorola Modular Tools (MMDS/MMEVS) for the TQSOCKET and TQPACK part numbers specific to the MCU in your target application.

Target Cable Connection to DIP-Based or SDIP-Based System

This technology is of the traditional through-hole-plated (THP) style. Sockets that take the same pin formation as the integrated circuits (IC) are cheap and readily available. For this type of technology, it is appropriate to use a simple plug and socket arrangement. Thus the user can insert and remove the target cable repeatedly. In addition, if required, the target socket can hold the target IC for final debugging and verification. **Figure 3** illustrates a typical arrangement.

Advantages: Interconnection between target and emulator is cheap and reliable. No additional adapter is required for MCU connection to the target system.

Disadvantages: Target heads can be bulky due to the larger package size.

Limitations: Requires that the IC socket be soldered directly to the target PCB.

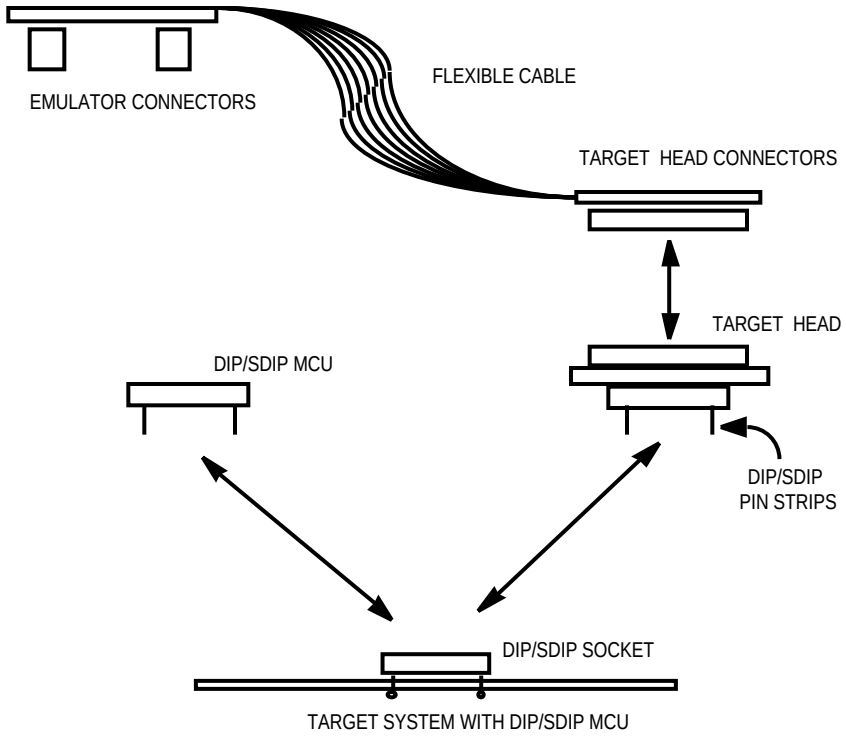


Figure 3. DIP or SDIP Target Cable

Target Cable Connection to PLCC-Based System

Although plastic leaded chip carrier (PLCC) is a surface mount technology, use of sockets for this package type is common. This is particularly true where the IC is a high value item.

Three forms of PLCC sockets are available. Two of these forms mount onto a printed circuit board (PCB) using through-hole sockets. The first is a production socket where the intention is to insert and remove the IC a limited number of times. The second is a burn-in/programming socket that allows repeated insertion and removal of the device. This form of PLCC socket generally is not suitable for use with this target approach because the socket release mechanism normally prevents secure contact between the target head and the socket. The third form of socket is a surface mount socket, which mounts to the footprint of a PLCC part. The target head for PLCC devices mimics the footprint seen by a PLCC socket (see **Figure 4**).

Advantages: Target cable can use socket already fitted for IC use. No additional adapter is required for MCU connection to the target system.

Disadvantages: The connection at the socket/target head interface has low mechanical strength.

Limitations: Requires that the IC socket be soldered directly to the target PCB.

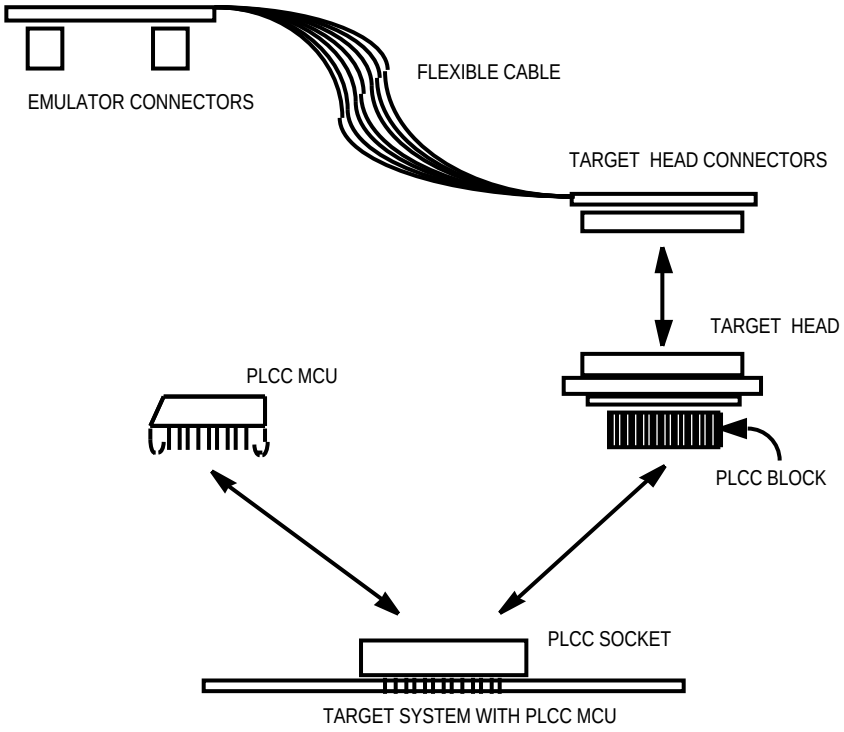


Figure 4. PLCC Target Cable

Target Cable Connection to Small Outline-Based (SOIC) System

SOIC is a surface mount technology. However, it is unusual to put an SOIC device into a socket – unlike the PLCC approach – and so supporting this technology requires a cheap, disposable target head. Another consideration is the space required by the head since SOIC packages often are found in tightly enclosed situations. **Figure 5** shows the solution adopted for this type of package. The appropriate DIP cable converts the emulator board pin out to the dual in-line format and then a special target adapter alters the DIP format to an SOIC outline. The user solders this DIP-to-SOIC adapter directly to the target PCB and then connects the DIP cable to the adapter via a DIP target head. However, on completion of the project, it may be difficult to remove the target adapter from the target system. So that the user can perform a final system evaluation using an SOIC MCU, a SOIC-to-DIP adapter is required as an interface between the MCU and the target adapter. (This can be supplied by Motorola, but customers should check part numbers and availability with a sales representative before ordering.)

Advantages: The target adapter is small in size. Interconnection to the surface mount footprint is reliable.

Disadvantages: The target adapter can be used only once and may be difficult to remove from the target system. The MCU requires an additional adapter to connect to the target adapter (see **Figure 5**).

Limitations: Target adapter is required to be soldered directly to the target PCB.

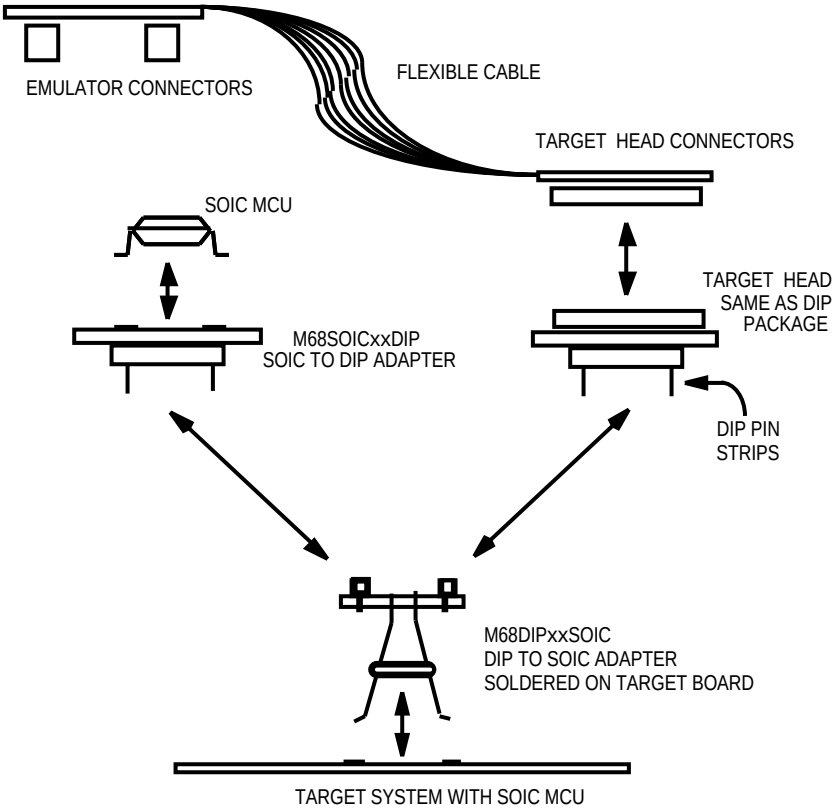


Figure 5. SOIC Target Cable

Target Cable Connection to Quad Flat Pack-Based (QFP) System

Quad flat pack is a surface mount technology. It achieves a higher density of signals in a smaller area than other packages by packing the connectors closer together. Like with the SOIC technology, the user normally solders the QFP devices directly to the PCB. The problem with QFP packages for both manufacturers and emulators is that the spacing between pins on the package is very small, requiring precision manufacturing equipment and skilled technicians. The target cable approach for QFPs involves a disposable target adapter (TQPACK), which the user solders directly to the target PCB. The target head connects to the TQPACK through a custom pin interface. The TQPACK shares the handling difficulties of the QFP package itself and the user typically will dispose of it once debugging is complete. However, removing the target system may be difficult. Should the user want to perform a final system evaluation using the QFP MCU, another adapter is required as an interface between the MCU and the TQSOCKET/TQPACK. (This can be supplied by Motorola, but customers should check part numbers and availability with a sales representative before ordering.) **Figure 6** illustrates the QFP concept.

Advantages: The target adapter is small in size. Interconnection to surface mount footprint is reliable.

Disadvantages: The target adapter can be used only once and may be difficult to remove from the target system. The MCU requires an additional adapter to connect to the target head (see **Figure 6**). Fine pin pitch is difficult to handle.

Limitations: Target adapter is soldered directly to the target PCB.

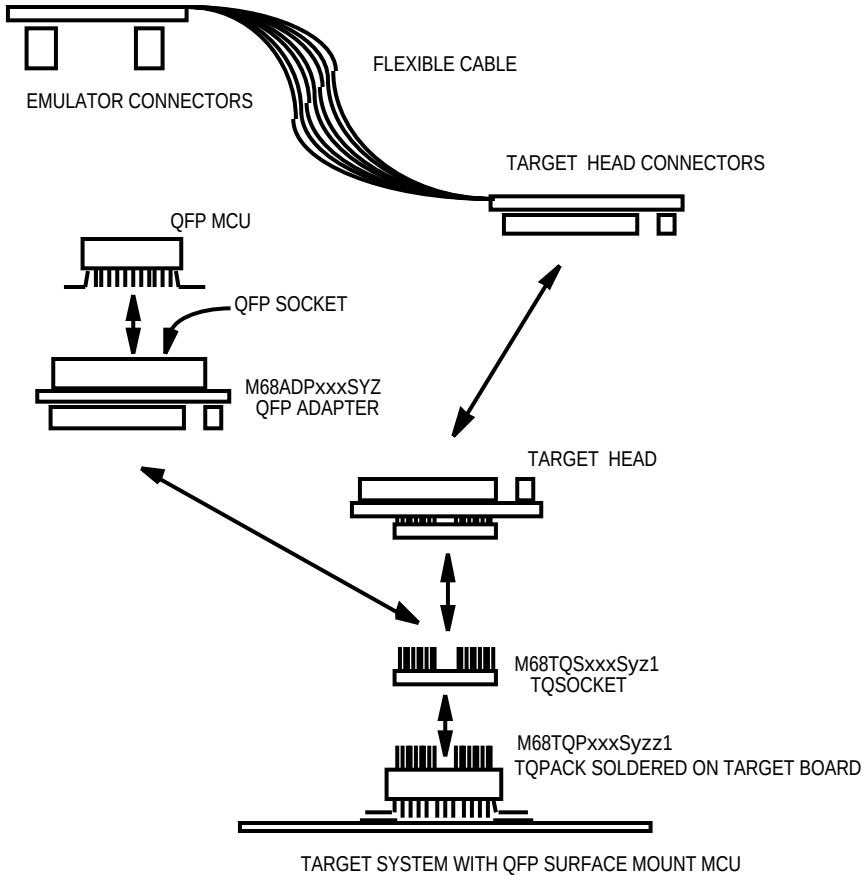


Figure 6. QFP Target Cable

Advantages of the Flexible Circuit Target Cable System

In addition to adding modularity to target package support, this cable also offers improved electrical and mechanical performance over other solutions.

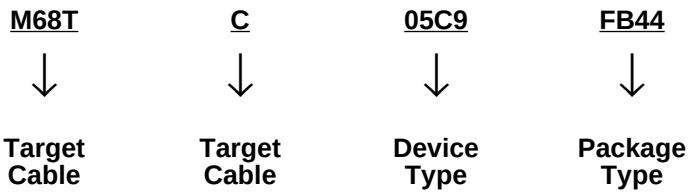
The mechanical improvements arise from the construction of the cable itself. A combination of flexible and rigid PCB technologies facilitates robust interconnection between target and emulator while retaining flexibility for awkward working environments. The connectors that interface to the emulator board, as well as those for the target head, mount on a rigid assembly for ease of handling and strong interconnection. These provide strong anchor points for the cable. A flexible circuit target cable provides the link between the emulator and target head connectors.

NOTE: *Although the cable is flexible, extreme distortion will damage it.*

Electrically, the cable takes account of the fact that logic and analog signals pass up and down the conductors, often at high frequencies. The conductors are impedance matched to improve the quality of the signals. In addition, the cable provides a number of redundant grounds (over and above the device grounds). These improve signal quality by reducing electromagnetic interference and ground path impedance. The cable design also further enhances the electromagnetic interference (EMI) and crosstalk performance by providing a ground track between each signal track.

Notes on Ordering Cables

The modular cable system requires the user to assemble a number of components to give the correct cable configuration. Consequently, the possibility of error is greater than with nonmodular cables. Currently, five cables are available (see **Figure 7**). Target head numbering depends on the original target MCU device (although it may support others) and the cable in use. **Figure 7** describes the part number of a typical target head and part numbers for complete cable systems are also listed. All parts (target heads, cables and other adapters) can be ordered individually. This is particularly advantageous for target head approaches involving disposable items, such as QFP and SOIC.



Where:

Target Cable	Denotes a target cable part number
Cable Type	Relates to M68CBL05x or M68CBL11x, for instance A, B, C, D, or E
Device Type	Describes the device supported (May also support others)
Package Type	Describes the package and number of pins, such as 44-pin QFP. Others include P (DIP), FN (PLCC), and DW (SOIC).

Figure 7. Target Head Part Numbers

Part numbers for a 44-pin PLCC cable for the M68EM05C9 emulator are:

1. **M68BL05C** — Flexible circuit target cable (Example shown is type C)
2. **M68TC05C9FN44** — Target head

Part numbers for a 20-pin SOIC cable for the M68EM05J1A emulator are:

1. **M68CBL05A** — Flexible circuit target cable type A
2. **M68TA05J2P20** — Target head
3. **M68DIP20SOIC** — Disposable target adapter

Part numbers for a 44-pin QFP cable for the M68EM05C9 emulator are:

1. **M68CBL05C** — Flexible circuit target cable type C
2. **M68TC05C9FB14** — Target head, shipped with one TQSOCKET and one TQPACK
3. **M68TQS044SAG1** — TQSOCKET with guide (Order if connecting to more than one target.)
4. **M68TQP044SAM01** — Disposable TQPACK (Order if connecting to more than one target.)

Table 2. Flexible Circuit Target Cables

Cable Type	Description
M68CBL05A	Up to 28 Pins
M68CBL05B or M68CBL11B	28 to 68-Pin Large Packages
M68CBL05B or M68CBL11B	28 to 68-Pin Large Packages
M68CBL05C or M68CBL11C	28 to 68-Pin Small Packages
M68CBL05D or M68CBL11D	68 to 100-Pin Large Packages
M68CBL05E or M68CBL11E	68 to100-Pin Small Packages

NOTE: *The information supplied here is correct at date of publication. Users should verify their requirements with a Motorola sales representative before ordering.*

Conclusion

Motorola supports a large range of common package styles with a modular cable strategy. The addition of more package styles is possible with the design and availability of the new target head being the key issues. Depending on the package style, an additional target adapter may be required which can only be used once since it is disposable. Other packages may require the user to provide a socket to match with the target cable.

The modular cable approach provides significant improvements over previous solutions both in performance and package support, with the ability to extend the support more easily in the future.

How to reach us:

USA/EUROPE: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

MFAX: RMFAX0@email.sps.mot.com – TOUCHTONE (602) 244-6609

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HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park, 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298