Portable Changeable Message Sign Handbook – Pcms

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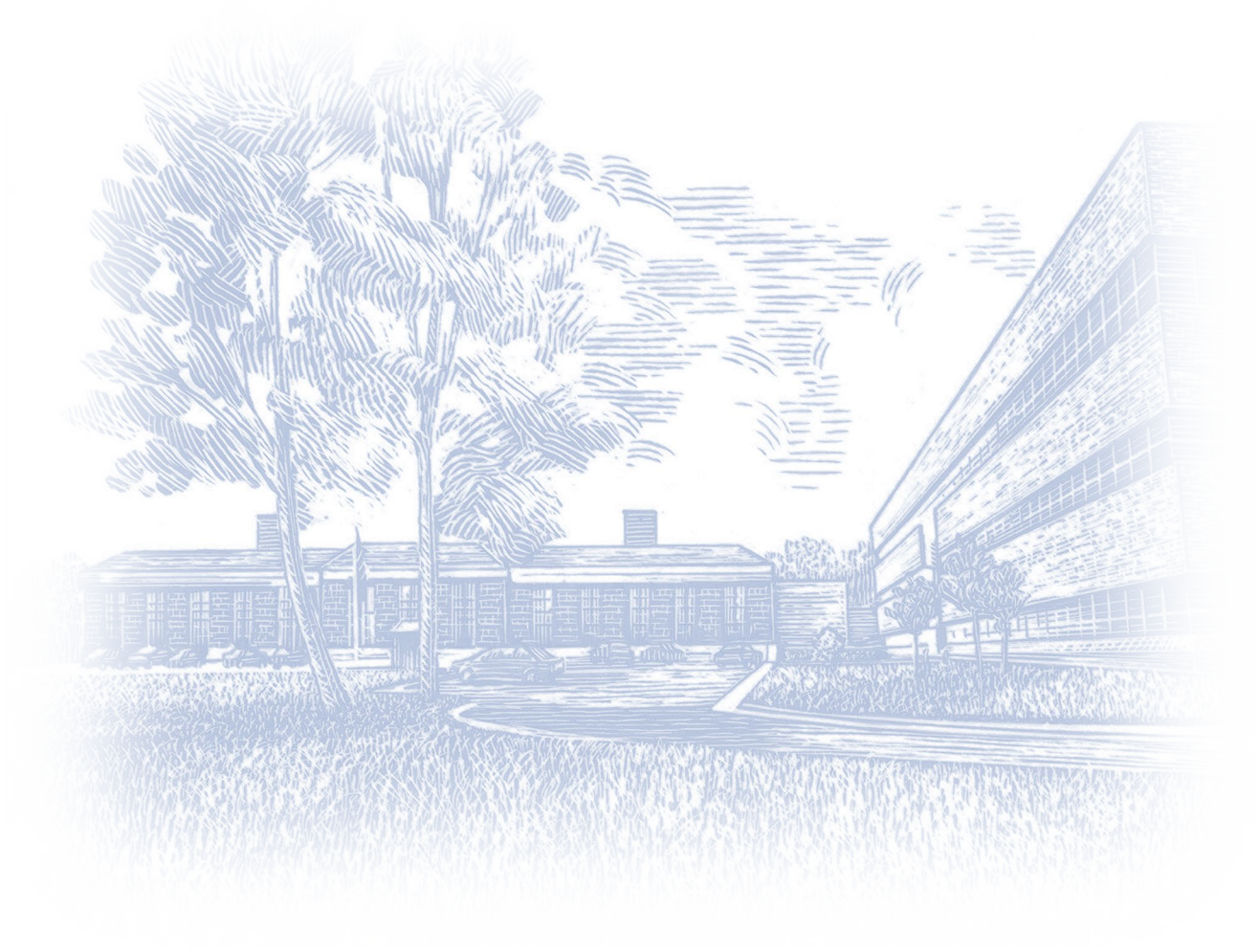

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Foreword

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The purpose of this handbook is to present basic guidelines for the use of portable changeable message signs (PCMS). This handbook presents information on the PCMS and is intended to illustrate the principles of proper PCMS use.

This handbook is not intended to be a standard.

Standards that apply to the PCMS are found in the *Manual on Uniform Traffic Control Devices* (MUTCD) at http://mutcd.fhwa.dot.gov/.

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WHAT IS A PCMS?

A PCMS is a traffic control device that is capable of displaying a variety of messages to inform motorists of unusual driving conditions. This capability is achieved through elements on the face of the sign that can be activated to form letters or symbols. The message is limited by the size of the sign (usually three lines with eight characters per line). A PCMS is housed on a trailer or on a truck bed and can be deployed quickly for meeting the temporary requirements frequently found in work zones or accident areas.

A PCMS:

- Captures motorists' attention.
- Relays information that is difficult to accomplish with static signing.
- Is used to supplement other required signing.

WHEN SHOULD A PCMS BE USED?

A PCMS can be used to alert and inform motorists during one of the following scenarios:

- Construction or maintenance (e.g., work zone).
- Incident management.
- Special event.
- Notification of future construction or event.

A PCMS can provide a unique message that alerts the motorist and supports standard signing for:

- Speed reduction.
- Advance notice of lane closures and shifts.
- Diversion to a different route.
- Advance notice of ramp closures.

A PCMS also can provide informational messages, such as:

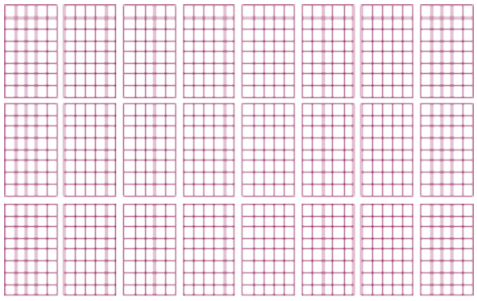
- Expected reopening of existing closed lane.
- Roadway status for special events.
- Crash or other incidents.
- Changes in alignment or surface conditions.

A PCMS can be an effective temporary traffic control device when used appropriately. By its very nature, it draws the attention of the motorist; however, this effect can be diminished if this device is overused. The PCMS should not replace any of the signing detailed in the MUTCD and should not be used if standard traffic control devices adequately provide the information the motorist needs to travel safely.

PCMS SCREEN CHARACTERISTICS

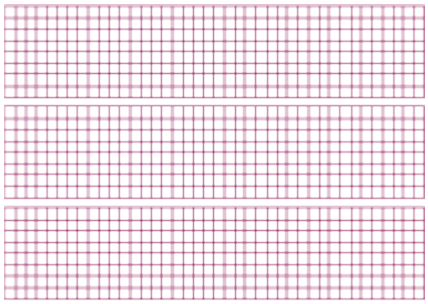
Matrix Types

The type of message screen can affect the message that is chosen and the distance at which it can be read. Three screen types (or matrix types) are described below:



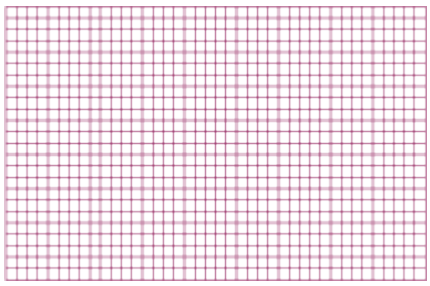
Modular- The simplest matrix-type signs are those that are comprised of character blocks. A sign would have, for example, three lines with eight character blocks per line.

Figure 1. Modular Matrix, comprised of character blocks.



Continuous Line Matrix- A somewhat more flexible type of PCMS uses a continuous matrix for each line of text. These signs offer the ability to use proportionally spaced fonts, as opposed to the monospaced text displayed by discrete character blocks. The benefits include a more natural-looking sign and, therefore, an easier-to-read message.

Figure 2. Continuous Line Matrix, continuous matrix for each line of text.



Full Matrix- The full-matrix PCMS is the most flexible type. The entire sign face is comprised of elements or pixels that can be activated to display a message. These signs offer the ability to vary the height of characters, display simple graphics, and use proportionally spaced fonts.

Figure 3. Full Matrix, comprised of elements that can be activated.

Depending on the matrix type, the height of a character can vary from 457 to 1372 millimeters (mm) (18 to 54 inches). Most PCMS units allow only eight characters on a line, no matter what the character height.

Each character shall, as a minimum, be five pixels wide by seven pixels high.

Table 1. Legibility distance.

Character Height, inches	Legibility Distance, feet
18	720
24	960
54	2160
1 inch = 25.39 mm 1 ft = .306 m	

The legibility distance of the character depends on its height. The legibility distances to the left are based on the standard that 25.4 mm (1 inch) characters can be read at 12.2 meters (m) (40 feet (ft)).

PCMS MESSAGE DESIGN PROCESS

Message Selection

PCMS use on construction and maintenance projects should be treated as an integral part of the traffic control plan (TCP). Desired messages, locations, and general time periods of display should be listed for all known or anticipated PCMS use during the project. Of course, additional opportunities to use the PCMS may come up during the life of the project, and the TCP should allow for these unanticipated messages. However, the governing agency should retain control over selection and display of the unanticipated messages.

Message Display

A PCMS message can use one, two, or, when absolutely necessary, three phases in which to relay its message. Below are message guidelines for the number of phases required to convey the message.

One-Phase PCMS:
Line 1—Describe problem.
Line 2—Identify location or distance ahead.
Line 3—Provide motorist instruction.

Two-Phase PCMS:
Phase 1—Describe problem.
Phase 2—Provide motorist instruction.

Three-Phase PCMS:
Phase 1—Describe problem.
Phase 2—Identify location or distance ahead.
Phase 3—Provide motorist instruction.

Care must be given to ensure a short message length and to avoid repeating messages covered by static signing.

Default Message

A default message should be programmed into the PCMS in case the unit becomes disabled. Since the default message will act as a warning to field personnel that the PCMS has malfunctioned, a message should be chosen that will not alarm motorists and will not be used for any other purpose. Alternatively, to indicate that the PCMS is malfunctioning, a pattern such as solid bars may be used.

Changing a PCMS Message

It is desirable to have the PCMS display the most correct and appropriate information to the motorist as possible. However, there are times when the PCMS will not have the desired message as one of the standard messages in the database. In this case, the required message must be added to the database.

The control system needs to include a display screen upon which messages can be reviewed before being displayed on the PCMS.

It is recommended that an instruction manual be stored with the PCMS for in-field programming of the message.

Standard Abbreviations

Abbreviations may be used when creating or editing PCMS messages. Do not make up abbreviations; use the following list of standard abbreviations to ensure that the motorist does not misinterpret the message.

Table 2. Acceptable Abbreviations

Word	Abbr.	Word	Abbr.
Alternate	ALT	**Minor**	MNR
Avenue	AVE	**Normal**	NORM
Boulevard	BLVD	**North**	N
Cannot	CANT	**Northbound**	NB
Center	CNTR	**Parking**	PKING
Do Not	DONT	**Right**	RHT
East	E	**Road**	RD
Eastbound	EB	**Service**	SERV
Emergency	EMER	**Shoulder**	SHLDR
Entrance	ENT	**Slippery**	SLIP
Enter	ENT	**South**	S
Expressway	EXPWY	**Southbound**	SB
Freeway	FRWY	**Speed**	SPD

Hazardous Material	HAZMAT	**Street**	ST
High-Occupancy Vehicle	HOV	**Temporary**	TEMP
Highway	HWY	**Traffic**	TRAF
Hour(s)	HR	**Travelers**	TRVLRS
Information	INFO	**Vehicle**	VEH
It Is	ITS	**Warning**	WARN
Junction	JCT	**West**	W
Lane	LN	**Westbound**	WB
Left	LFT	**Will Not**	WONT
Maintenance	MAINT		
Major	MAJ		
Miles	MI		

Table 3. Acceptable Abbreviations with Prompt Word

Word	Abbr.	Prompt
Access	ACCS	Road
Ahead	AHD	Fog*
Blocked	BLKD	Lane*
Bridge	BRDG	(name)*
Condition	COND	Traffic*
Congestion	CONG	Traffic*
Construction	CONST	Ahead
Downtown	DWNTN	Traffic*
Exit	EX, EXT	Next*
Express	EXP	Lane
Hazardous	HAZ	Driving
Interstate	I	(followed by route number)
Local	LOC	Traffic
Lower	LWR	Level
Major	MAJ	Crash

Minor	MNR	Crash
Oversized	OVRSZ	Load
Prepare	PREP	To Stop
Pavement	PVMT	Wet*
Roadwork	RD WK	Ahead
Route	RT	Best*
Turnpike	TRNPK	(name)*
Township	TWNSHP	Limits
Upper	UPR	Level
*Prompt word goes before abbreviation.		

Table 4. Abbreviations That Are Not Acceptable

Abbr.	Intended Word	Common Misinterpretation
ACC	Accident	Access (Road)
B4	Before	None
CLRS	Clears	Colors
DLY	Delay	Daily
FDR	Feeder	Federal
L	Left	Lane (Merge)
LT	Light (Traffic)	Left
PARK	Parking	Park
POLL	Pollution (Index)	Poll
RED	Reduce	Red
STAD	Stadium	Standard
WRNG	Warning	Wrong

REMEMBER:

- Signs are the primary channel of communication to the motorist.
- PCMS credibility is crucial.
- The PCMS should communicate what action motorists need to take and when this action should occur.
- Unnecessary information should be avoided.
- PCMS should be left blank if there is nothing to report and moved if no longer needed.

Display Time

Each phase of a PCMS should be displayed long enough to allow reading by the motorist; however, unnecessarily long display times should be avoided. The following display times are suggested:

- Phases with one or two lines: 1.5 seconds.
- Phases with three lines: 3 seconds.

Maximum Number of Phases

The PCMS should have adjustable display rates so that the entire message can be read at least twice at either the posted speed, the off-peak 85th percentile prior-to-work-starting speed, or the anticipated operating speed. Given the need to display each phase for 1.5 to 3 seconds, there is a practical limit on how many phases can be displayed to the motorist for any one message. Concise design should be used to limit the message to two phases.

The conditions in the following table could allow motorists sufficient distance and time to read three phases twice.

Table 5. Conditions are based on a presumed PCMS minimum character legibility.

Character Height, inches	Speed, mph
18	40
24	50
54	Any
1 inch = 25.39 mm 1 mile (mi) = 1.61 kilometers (km)	

These conditions are based on a presumed PCMS minimum character legibility of 40-to-1 of character height. It should be noted that different technologies will affect the character legibility.

REMEMBER:

- One-phase messages are ideal.
- Two-phase messages are acceptable if necessary.
- Three phases should be used only when necessary and should contain a simple message.
- The message can be split into two PCMS units if desired.
- Do not flash a message to attract the motorist's attention. This practice has been found to be a distraction to motorists, especially at night.
- Do not allow the message to scroll or travel horizontally or vertically across the face of the sign.

PLACEMENT OF A PCMS

Laterally

If possible, the PCMS should be placed closest to the lane for which the message applies. The PCMS normally is placed on or just outside the shoulder. A PCMS can become a roadside hazard if not protected from an errant vehicle. If it cannot be protected by a guardrail or barrier, then it is recommended that orange cones or drums be used to increase the likelihood that motorists will notice the PCMS.

Care should be taken not to place the PCMS so far off the roadway that the PCMS is not in the motorist's cone of vision long enough to read the message. Factors that change the motorist's cone of vision are:

- Distance the PCMS is placed from the side of the road.
- Number of lanes.
- Roadway curvature.

In addition, the PCMS should be placed on level ground and turned 3 degrees toward the roadway from the perpendicular edge of the roadway to reduce glare.

Longitudinally

The placement of a PCMS depends on how far upstream it needs to be placed and whether the upstream location has a sufficient sight distance for the PCMS to be viewed before motorist action is required.

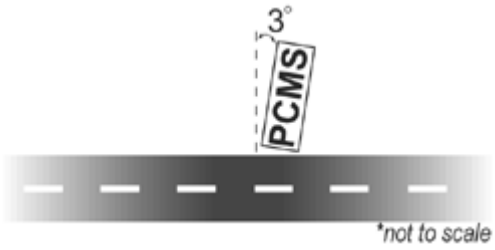


Figure 4. Illustration of placement of a verticle PCMS sign.

The upstream location from the decision point depends on what type of action is required of the motorist. An example of a minor action is a lane change by the motorist. A major action would be the motorist having to make a detour from the current road.

For a minor action, the PCMS should be placed from 152.5 m to 305 m (500 ft to 1,000 ft) upstream of the decision point, regardless of speed.

For a major action, if the speed is less than or equal to 64 kilometers per hour (kph) (40 miles per hour (mph)), the PCMS should be placed at least 305 m (1,000 ft) upstream of the decision point. If the speed is greater than or equal to 72 kph (45 mph), then the PCMS should be placed at least 1.61 km (1 mi) upstream of the decision point.

There should be a minimum spacing of at least 305 m (1,000 ft) between PCMS units or a PCMS and an arrow panel. Multiple PCMS units should be placed on the same side of the roadway.

PCMS Height

When in operating mode, the bottom of the PMCS message panel shall be at least 2 m (7 ft) above the roadway.

Sight Distance

For highway travel, it is desirable to have a visibility distance of 0.8 km (0.5 mi) for a PCMS, while for slower travel, shorter distances are acceptable. Keep in mind that because curves or hills may hide a PCMS, the PCMS may have to be located farther away from the decision point so that there will be enough time for the motorist to read the message.

In placing a PCMS, it is important to keep in mind that:

- The PCMS should be visible from 0.8 km (0.5 mi).
- Curves or hills may require an increase in spacing.

After the PCMS has been located in the field, verify that the sight distance is greater than the required visibility and legibility distances.

Finally, because local motorists become familiar with the new conditions so quickly, the PCMS should be moved periodically (e.g., every few weeks) so that it continues to command the attention of motorists.

WHEN TO DISCONTINUE PCMS OR ALTER MESSAGE

One of the most significant problems perceived with a PCMS is credibility. A failure to display the correct information on a PCMS creates a negative image in motorists' minds.

REMEMBER:

- Update PCMS information when possible.
- When not in use, the PCMS should be turned perpendicular to the flow of traffic so that motorists do not see its screen (if possible).

OTHER OPERATIONAL ISSUES

Brightness

Current PCMS boards operate by means of one of two technologies (neither of which allow for an adjustment of field brightness):

- Light-emitting diode (LED) boards are internally set at the factory to monitor ambient light levels and automatically adjust the brightness of the PCMS. These boards do not allow manual overriding of light intensity.

  If an LED board is too dim under sunny conditions, or is excessively bright at night, that board should be replaced or it should be adjusted by the manufacturer.

- Flip-disk boards have no light source to be adjusted, as these are usually reflective disks.

Maintenance

As with all mechanical equipment, routine maintenance is recommended to preserve the life of the PCMS and to ensure that it is running safely and properly.

Suggested maintenance steps include:

- Have an extra battery available (if the PCMS is battery-powered).
- Clean and inspect the following components:
  - Screen (monthly).
  - Sign door panel(s) (monthly).
  - Solar panel(s) (monthly).
  - Batteries (three or four times per year).
- Verify that an extra set of programming instructions are stored in the PCMS for emergency use or for "in-the-field" programming.

APPENDICES

Setup Checklist

- ✓ Does the PCMS tell the motorist to do something?
- ✓ Are static signs not readily available?
- ✓ Does the PCMS tell drivers something new?
- ✓ Has approximately 1.5 to 3.0 seconds of cycle time been provided for each phase of the PCMS so that each phase can be read twice?
- ✓ Have standard abbreviations been used?
- ✓ Can the PCMS be seen from the recommended visibility and legibility distances?
- ✓ Is the PCMS safely placed on or just off the shoulder?

REMEMBER:

- Move the PCMS periodically so that it continues to command the attention of the motorists.
- Black out or edit the PCMS message when it no longer applies.
- Ensure that the brightness of the PCMS changes automatically as required by lighting conditions.
- Maintain and clean the PCMS on a regular basis

Definitions

Character—Letter, numeral, or symbol formed by a group of pixels, usually an array of five-wide by seven-high pixels.

Cycle Time— Time that the entire message is displayed.

Graphic—Array or configuration of pixels that forms an image or symbol for the purpose of conveying information.

Legibility Distance—Distance at which a motorist with normal vision can read a message.

Message—Group of characters, numerals, and symbols or a graphic image used to convey a warning or instruction. A message may be presented to the motorist during one, two, or three phases.

Phase—Letters, words, and/or symbols displayed at one time.

Table 6. Metric Conversions

From English	Multiply By	To Metric
inch	25.4	millimeters (mm)
foot	0.30	meters (m)
yard	0.91	meters (m)
mile	1.61	kilometers (km)
mph	1.61	kilometers per hr (kph)